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THE AMERICAN ARCHITECT AND BUILDING NEWS

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ARCHITECTVRE

ENGINEERING

DECORATION

CONSTRVCTION

TICKNOR & COMPANY

BOSTON MASS.

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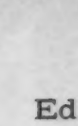
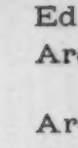
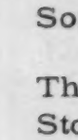
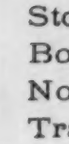
House built in Connecticut in 1880.

REVIEW OF THE PRINCIPLES OF SANITARY PLUMBING AS NOW ACCEPTED BY ALL LEADING SANITARIANS.

THE main object to be attained is the complete removal of waste matters from the premises the instant they are generated. This can only be accomplished by observing the following rules: — (1.) Avoid all cesspools. (2.) Make all waste-passages as small as possible to effect their purposes. (3.) Construct every fixture on the principle of the flush-tank. (4.) Make every trap seal-retaining and self-scouring. (5.) Make all joints tight. (6.) Select the simplest appliances and the simplest system consistent with safety. These rules are self-evident enough to be accepted as plumbing axioms, and are sufficient to produce perfect work. The "Sanitas" Appliances have been constructed with a view to their fulfilment in every respect, and an examination of the steps leading to the development of these appliances will best illustrate the principles of Sanitary Plumbing, showing the faults which should be avoided, and the objects which should be sought.

Beginning with the trap: In the first place mechanical seals have been discarded as being unreliable, unnecessary, and as obstructing the water-way. We start with the simplest form of water-seal trap, the ordinary S-trap. This trap answers all our requirements except that it has no power to retain its seal under the variations of atmospheric pressure occuring within the waste-pipes. To remedy this deficiency the pot-trap was developed from the S-trap by simply enlarging its upcast limb, a sufficient enlargement gives it a temporary power of resistance, but creates a cesspool having no self-cleansing power and, accordingly, the trap clogs, under sinks, with grease and ultimately loses its original resisting power. To avoid this difficulty we have turned the pot-trap on its side and reduced the size of its body. This permits the air to pass through the trap above the water without driving the latter out before it, as would be the case with a perpendicular body equally reduced in diameter. To still further increase the power of resistance to siphonage the body was next bent into a quadrangle, giving several reflecting surfaces, which throw back this water under siphoning action while they allow the air to escape, and, finally, the two parallel sides of the quadrangle were merged into a single body having a reflecting partition and a large clean-out cap. This gives us the perfected Sanitas-Trap, which has proved itself to be both anti-siphonic in properly arranged plumbing-work and substantially self-cleansing either with or without venting. It is more resisting than a vented S-trap.

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APPLIANCES

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The Sanitas is a Scientific System of Plumbing, having Simplicity and Safety for its Basis. It is also by far the most Economical System.

Avoid Infringements and Imitations which are described as being "as good as the 'Sanitas;'" they are not, they are very inferior as well as illegal.

Considering next the Lavatory. These should always be constructed on the principle of the flush-tank, their discharges filling the water-passages "full-bore," so as to keep them clean. The overflow and outlet passages should be combined in the form of a stand-pipe, thus doing away with the usual foul, inaccessible and badly jointed lead overflow-pipe, and the troublesome and dirty plug and chain. The stand-pipe should be operated by a simple mechanism above the slab, for convenience and cleanliness, requiring but a single movement of the hand, and all parts should be of solid and durable construction, while the stand-pipe should be easily detachable for cleansing. The Sanitas Lavatories are all constructed after this principle, and they are the first ever so constructed. The stand-pipes are made of either plated metal or of earthenware, like the fixture itself, and the whole device produces a very ornamental effect, especially when decorated in colors to correspond with the decoration of the earthenware bowl. Finally, the ideal water-closet should have the simplicity of the short-hopper, with the sanitary advantages and convenience of the improved modern closets. More than this, it should be practically noiseless, anti-siphonic, quick-acting, self-sealing, and free from spattering or waste of water. These desiderata have been attained in the Sanitas Water-Closet of which we sketch the outline in section. The supply-pipe between the cistern and the closet discharges into the latter below the level of its standing water, and being without air-pipe, stands permanently full of water, hence the action is instantaneous and the noise of flushing is deadened. This and the peculiar construction of the flushing-rim and water-supply passages cause the waste to be discharged with wonderful speed and effectiveness; and at the same time so quietly that with the cover down and the toilet-room door closed, no sound of flushing can be heard from without. The closet is highly ornamental in appearance, hence no other wood-work is required than the seat and cover, and these may be supported directly on the earthenware itself, which is constructed with this in view. The Sanitas System, taken together, is the most economical as well as the only safe system of plumbing, as avoiding the dangers and complication of special trap venting. Whether vented or not it is now admitted that safety requires a trap to be *anti-siphonic*, the vent-pipe alone not being reliable. The Sanitas Trap holds sufficient water to resist, when properly set, any *back pressure* that can occur in good plumbing with properly vented soil-pipes. For more detailed description and illustration of the Sanitas Appliances, see our other Advertisements and the Circulars of

THE SANITAS MANUFACTURING CO., BOSTON.

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THE *British Architect* has, as we believe, done a serious injustice in commenting on the correspondence published in these columns some weeks ago, under the heading of "Chances for the Morally Infirm." Our readers will remember that a correspondent sent to us for publication a number of letters from manufacturers and dealers, offering discounts, commissions or perquisites to architects who might specify or order their goods. As an offset to this another firm published a letter from the original correspondent, inquiring its "lowest possible discount to architects." The *British Architect* says that "There is, of course, only one construction to be put on such a letter," and goes on to argue that the fact that dealers offer unlawful inducements to architects to use their goods is a proof that such inducements are not only "readily accepted in many cases," but are in many others "demanded as a rightful perquisite." Now, without referring to the particular case in question, we must express our conviction that the *British Architect* is wrong in supposing that "only one construction" can be put on a letter like that quoted; and that just such letters are written every day by architects, not only with the purest intentions, but from a conviction that their duty to their clients obliges them to do so. In the first place, we are sure that the great majority of decent architects regard the whole system of concealed discounts and commissions as an unspeakable nuisance, and regard with loathing and contempt the ideas of business which permit manufacturers to offer them, and to try to allure as customers the creatures who accept them. Nevertheless, the system exists, and architects must do best they can with it. The easiest way would be to certify for the "list," or "long" price for everything which their customers have to pay for, justifying themselves by comparing the printed price-list with the charge on the bill, and washing their hands of all endeavor to inquire whether this is the real value of the article. Unfortunately for the conscientious and pains-taking architects, they soon discover that the list-price and the real selling-price of the goods used in building are two very different affairs, and that, while the amount of discount is studiously concealed from persons not connected with the business, the architect who does not contrive to discover it, and who pays the "long price" for what he buys, or orders for his client, is looked upon by the dealers as a fool, while, even if his client does not discover that the goods might have been had cheaper, and reproach him, he is troubled by his conscience for not having made due effort to save his employer's money.

IF the discount were a trifling one, the matter would not be worth spending much time over, and architects might certify bills by the simple process of comparing them with the price-lists, and save an immense amount of time and temper; but in many cases the difference between the true and the ostensible price is enormous, while strenuous efforts are made to conceal it from architects and their clients. We once had a bill to certify which we knew was too large. We went to the dealer, who was at heart an honest man, and were informed that there was a regular discount on those goods of sixty per cent. We asked him to make a note of the deduction on the bill, so that it could be certified; but he refused, saying that the dealers never allowed the discount to appear on the bill, but that if we would get for him a check for two-fifths of the face of the account, he would receipt the bill in full. In this case, as in most others, the discount was strictly confined to dealers and architects, and could only be allowed to them, persons outside the trade being, in theory, always required to pay the full price. In many instances, where the discounts are very large, the rule in this country is not to allow them on a bill sent to an architect to certify, unless he will consent to have the bill made out to himself; the explanation usually given being that the dealer is bound to "protect" his agents, or customers who buy to sell again, by selling nothing to "outsiders" below the list-price, and that in order to escape the penalties attached to an infraction of this rule, it is necessary to be able to show other persons in the trade that the sale was really made to the architect, who ranks in theory as a general agent for the sale of all sorts of building-materials. After a few years' experience by this method of doing business, in which the architect can often buy the goods that his client wants for less than half, or as we have known, less than one-third the amount that would be charged on a bill sent directly to his client, and can almost always secure a large reduction from the ostensible price, many architects save trouble in trying to ascertain the cost of such articles, by inquiring directly the "price to architects," or the "architect's discount," instead of wasting time in consulting price-lists which they know are intended simply to deceive. Most architects of large practice, who, as all architects are sometimes obliged to do, purchase materials for their buildings directly, instead of specifying them, and letting the contractors settle the bills, can save considerable amounts for their clients in this way, and feel themselves bound to do so; and the idea of the *British Architect*, that, when an architect asks a dealer how much cheaper goods will be sold to him than to his client, it is necessary to infer that he intends to steal the difference in price for himself, strikes an American as ridiculous. It is hard enough for architects to be obliged to spend their precious time in finding out how to get things at their value for those who trust them, without being accused of corrupt intentions, and we venture to say that most decent members of the profession would be considerably better off at the end of each year if "trade discounts" were by law either abolished or fixed at a reasonable amount. Of all the provoking experiences of an architect's office, the worst is to be told by a contractor in handing in his estimate, "that twenty per cent goes to the architect," or "twenty-five per cent of this is for you," or to have, as in one instance in our experience, a check for five thousand dollars, to the architect's order, laid down quietly in a conspicuous place. The architect's first impulse is to kick the contractor and his check down stairs; but his next thought is for his client. If the contractor, who is often in these cases the lowest bidder, can afford to do the work, and spare, out of his profits, a douceur of twenty or twenty-five per cent to the architect, is it not the latter's duty to his client to save this amount for him? In most cases the architect immediately deducts the discount from the tender, and persuades the contractor to sign an agreement for the net amount; but contractors often refuse to make any discount unless the architect receives it, and the latter is sometimes reluctantly compelled, by what he conceives to be his duty, to accept it, and hand it over to his client, generally with a resolve to have no further dealings with that contractor.

BOSTON has long been afflicted with a very tyrannical and arbitrary society of a trade which is noted for its domineering habits, — that of the freestone-cutters. For many years the Freestone-cutters' Union has interfered with the business of contractors, interrupted the progress of buildings, and hunted non-Union men like rats, without finding any one brave enough to resist its dictation. Early last year, however, one of the oldest and best contractors in the city, Mr. Carew, happened to take into his shop a printer, who wished to try his

hand at stone-cutting. He was slow and awkward at first, but Mr. Carew paid him what his work was worth, and the man was not only satisfied, but grateful. The managers of the Union, however, saw a chance to make trouble, and gave notice that the printer must be paid full stone-cutter's wages. This obliged Mr. Carew either to pay his man more than he earned, which neither of them thought fair, or to turn him off altogether, which might be fair, but was an injury to the man which Mr. Carew disliked to inflict. He accordingly declined to obey the managers' commands, and his men were called out. Being a person of considerable courage, and fortified also by a thorough knowledge of his business, and a high reputation for honesty and skill, Mr. Carew resolved not to yield, and began immediately to take measures for filling his shop with non-Union men. The Union fought hard, but he availed himself of the opportunity of taking as many apprentices as suited him, instead of restricting himself to the small number allowed by the Union dictators to their subject masters, and by his own exertions, aided by the free men whom he gradually gathered around him, he fulfilled his contracts. The next step was to get workmen from abroad, and by the end of a year from the time of the strike he found himself with a full equipment of excellent men, working at good wages, and not bound by oath to try to destroy his business at a signal from a scheming demagogue. On finding that their bullying had not worked as they thought it would, the Union managers next resorted, as usual, to sneaking and whining. One night Mr. Carew's shop was broken into, and all his tools taken to the edge of the wharf, and thrown into the harbor. Then followed libellous attacks in the newspapers, which were persuaded to say that Mr. Carew had put bad work into the stone furnished for one of the city buildings. Fortunately, his reputation enabled him to laugh at these attempts to injure him anonymously, and he replied, with considerable force, that as the men who were attacking him were the ones who did the work on the building in question, whatever bad work was done must have been done by them.

IN another column will be found some account of the curriculum followed in the architectural department of the Massachusetts Institute of Technology which was prepared some weeks ago and consequently has not been quite brought down to date. Since it was written Professor Clark has retired and has been succeeded by Mr. F. W. Chandler, the first-named gentleman resuming the practice of his profession which had been partly interrupted by the demands made on him by the work at the Institute, while Mr. Chandler on the other hand abandons — for the present at least — all active architectural practice to devote himself entirely to his new work. For ten years or more Mr. Chandler has been associated with Mr. E. C. Cabot, passing to that office from the office of the Supervising Architect at Washington where he was for some time head-draughtsman during the incumbency of Mr. Mullet. Before this he had been for several years in the office of Ware & Van Brunt, and during this time he spent at least one year as assistant to Professor Ware in the early years of the evolution of the department at the Institute. So he takes up the work not only as an architect of thorough training and much practical experience but also as one who has already had experience in the task of training adolescent architects. In deciding against making the attempt to "ride two horses" as both his predecessors have done, Mr. Chandler decides most wisely. There is enough to be done in such a place to occupy a man's full time, and the chances of the department becoming such a school of real architecture as the times demand is greatly increased by his decision on this point. But unless the trustees and the government of the school experience a change of heart there is little hope that the grade of work can be carried far above its present level. For years this department of the Institute was the only one that was not carried on at a loss, but instead of being treated with more generosity on this account it was considered as a sort of nursing-mother to the other departments which could not support themselves, and the library and collections which might have been paid for out of its own income were obtained through private aid, and even at this day they are, for a department which has been in successful operation for nearly twenty years, ludicrously inadequate. As an adjunct of a school of applied science the department is out of place; it ought rather to be associated with the School of Drawing and Painting at the Museum of Fine Arts. Mr. Chandler has our hearty good wishes and sympathy, and we feel he will need this, for we cannot believe that he shares the belief of the authorities of the Institute that architecture is only "an industrial art."

A MYSTERY still seems to hang about the competition for the new Episcopal Cathedral of New York. So far as we can ascertain, the competition is to be a limited one, but the accounts of the degree of limitation differ widely. According to one newspaper item, several American and a certain number of English architects have been, or are to be, asked to compete, while a later account says that twenty architects of New York have been invited; and it seems to be uncertain whether the time for terminating the contest is to be December 15th or 31st next. A curious provision in the invitations is said to be that the church shall face the south. Whether this means that the principal entrance shall be by a south porch, as, for instance, at Chartres, or that the usual orientation shall be abandoned, on account of the topography, or for some other reason, we cannot say, but hope that the public may be allowed later to know more of a subject which has excited such general interest.

THE San Francisco Chapter of the American Institute of Architects has now in hand the subject of Competitions. The matter is in the hands of a special committee, which has not yet made its report, but, as we learn from the *California Architect*, an informal discussion took place upon it at the last meeting of the Chapter, and some curious facts were mentioned. One member described a case where competitive designs were invited for a large public building. Eleven sets of drawings, comprising seven sheets each, were received, and opened by the committee in charge. In an hour after the plans were open, the award was made. As the narrator pointed out, it was impossible that seventy-seven drawings should have been examined, even hurriedly, in one hour by a committee, and the inference could only be that the "successful" competitor had been decided upon beforehand. We have heard of a committee-man who, in a similar case, was asked why other architects should be induced to spend time and money in making drawings in competition for a commission which had already been promised. He answered, very innocently, that the committee thought it would be well to get the ideas of other architects, as they might be of use to the young man who was going to do the work; and this is very often the sole object of the so-called competitions managed by laymen. According to the San Francisco architects, at least ninety per cent of the public competitions which take place on the Pacific Coast are of this character, but, as the best part of the profession there has taken the subject up, we may hope that a reform will be brought about before long.

SOME extraordinary building operations are just now going on in Chicago. The structure known as the Old Chamber of Commerce has been purchased by a firm of lumber dealers, and is to be converted into offices, by the curious process of addition at top and bottom. The present building is three stories high, the upper story consisting of a large hall. This is to be divided horizontally into three stories, by the insertion of two floors, and seven stories more are to be added above, making twelve stories in all. As the present foundations are altogether inadequate to the support of this weight, they are to be removed from beneath the new building, and heavier ones inserted. Meanwhile, the superstructure will be supported on three thousand jack-screws. The architect in charge of this remarkable operation is Mr. Frederick Baumann, whose name is enough to indicate that it will be thoroughly and skilfully carried out. In another part of Chicago a large office building is to be raised six feet, to accommodate it to a new street grade. This will also require about three thousand jack-screws, although the work itself is much simpler than in the other case. It seems as if some of our building raisers, whose fame is world-wide, might with advantage extend their business to the other side of the ocean. In a profession where so much depends upon experience, and the skill that comes by practice, they would for a long time surpass all others, while they might in their turn find something to be learned, in England, for instance, where the restoration of a tower to the perpendicular, by lifting one side of the foundation, an operation as yet untried, we think, in this country, was successfully accomplished a few months ago.

ARCHITECTUAL EDUCATION IN THE UNITED STATES.
I.

THE MASSACHUSETTS INSTITUTE OF TECHNOLOGY.

THE Institute of Technology was the first school in the country to open a regularly established department of architecture which has been sufficiently prosperous to maintain itself. The charter of the institution was granted by the legislature in an act dated April 10th, 1861. The School of Industrial Science was opened in February, 1865, and the Department of Architecture was created in 1866, though there were no regular graduates until 1873. William R. Ware, an architect of Boston and an ex-pupil of Mr. R. M. Hunt of New York, was placed in charge of the department, and continued as its head until 1881, the high standing of the Institute being largely due to Prof. Ware's personal influence, and his untiring and enthusiastic work. He raised the department from nothing to the first rank in the country. On being called to Columbia College, New York, he was succeeded for a time by W. P. P. Longfellow and T. M. Clark as associate professors. Prof. Longfellow, however, retired from the department at the end of a year. Prof. Clark had studied or worked with Mr. Richardson for some seven years and was employed in the building of Trinity Church, Boston, and several of Mr. Richardson's — or more properly Gambrill & Richardson's large works. Both Prof. Ware and Prof. Clark have been ably seconded in their efforts by the work of an assistant, Prof. Eugène Létang, who was brought over from Paris in 1872, through the efforts of Prof. Ware and has practically had control of the architectural designing and drawing ever since, and has contributed very largely to the popularity and success of the department. Prof. Clark has also two assistants, Mr. Homer and Mr. Perkins, who give lectures and supervise the drawing classes, besides a few special lecturers who will be referred to later on.

The courses of study in the Institute are very strictly laid down in the curriculum, and students are not allowed to depart from them. The regular course extends through four years, but, as in nearly all of the architectural schools in the country, it has been found that a great many students are not willing to give so much time to the study of architecture, and a special course has been provided, extending through two years. A large majority of the architectural students content themselves with this course instead of following the more extended one.

The special course as laid down in the catalogue is as follows: —

FIRST YEAR.

FIRST TERM.	SECOND TERM.
The Orders and Elements of Architecture.	Original Design.
Sketching and Water-Color.	Sketching and Water-Color.
Mechanical and Free-hand Drawing.	Mechanical and Free-hand Drawing.
Materials.	Shades, Shadows, and Perspective.
Elementary Mechanics.	Common Construction.
Architectural History.	Graphical Statics.
	Architectural History.

SECOND YEAR.

FIRST TERM.	SECOND TERM.
Original Design.	Original Design.
Sketching and Water-Color.	Sketching and Water-Color.
Specifications.	Specifications and Contracts.
History of Ornament.	History of Ornament.
Problems in Construction.	Planning.
Ventilation and Heating.	Iron Construction.
Working-Drawings and Framing.	Schools, Theatres, Churches.
	Ventilation and Heating.
	Surveying.
	Stereotomy.
	Problems in Construction.

The regular course is the same for all departments of the Institute during the first year, and is confined to general studies, with the single exception of a large amount of mechanical and free-hand drawing. No one is allowed to continue in the department of architecture who does not have credits in mechanical drawing, including geometrical drawing, shades and shadows and descriptive geometry.

The regular course is as follows:

FIRST YEAR.

FIRST TERM.	SECOND TERM.
Solid Geometry.	Algebra.
Algebra.	Plane Trigonometry.
General Chemistry.	General Chemistry.
Chemical Laboratory.	Chemical Laboratory.
History of the English Language.	Political History since 1815.
English Composition.	French (or German).
French (or German).	Mechanical and Free-hand Drawing.
Mechanical and Free-hand Drawing.	Military Drill.
Military Drill.	

SECOND YEAR.

FIRST TERM.	SECOND TERM.
Materials.	Original Design.
Architectural History.	Common Constructions.
Drawing.	Architectural History.
The Orders and Elements of Architecture.	Shades, Shadows, and Perspective.
Analytic Geometry.	Sketching.
Physics.	Differential Calculus.
Descriptive Geometry.	Physics.
Political Economy.	English Prose.
German.	German.

THIRD YEAR.

FIRST TERM.	SECOND TERM.
Original Design.	Original Design.
Sketching and Water-Color.	Sketching and Water-Color.
Working Drawings and Framing.	Iron Construction.
Lectures on Fine Art.	Kinematics and Dynamics.
Integral Calculus.	Strength of Materials.
General Statics.	Stereotomy.
Structural Geology.	Physical Laboratory.
Physics: Lectures and Laboratory.	European History.
German.	German.
	Acoustics.

FOURTH YEAR.

FIRST TERM.	SECOND TERM.
Advanced Original Design.	Advanced Original Design.
History of Ornament.	Sketching in Water-Color.
Sketching in Water-Color.	Planning.
Problems in Construction.	Schools, Theatres, and Churches.
Specifications.	Problems in Construction.
Strength of Materials.	Specifications and Contracts.
Lectures on Fine Art.	Constitutional History.
Heating and Ventilation.	Heating and Ventilation.
Advanced French.	Advanced French.
	Thesis Work.

The two-year special course thus includes the mechanical and free-hand drawing of the first year of the regular course, the drawing and design of the regular second and third year, and the more strictly professional lectures of the second, third and fourth years, with a practical course of its own in trigonometry and graphical statics, without the higher mathematics, which are pursued quite extensively during the four years' course. Prof. Clark does not altogether approve of the idea of having special courses, but the majority of students now prefer them so that it is doubtful if any decided change will be made at present.

It will be seen that the course comprises, practically, quite an extended university education in addition to the technical studies directly related to architecture. The school sessions begin in the morning at nine o'clock and last until about five, giving, on an average, seven hours a day devoted to recitations and drawing. Of the total time during the whole course, 285 hours are given to pure mathematics; 110 to applied mathematics; 420 to languages; 530 to miscellaneous studies, such as geology, history, physics, etc.; 321 to lectures upon the theory of architecture; 105 to construction; and the balance of 3269 hours to drawing and designing. In other words, general university studies occupy 1345 hours or 25 per cent; the theory of architecture 426 hours, or 10 per cent; drawing and designing 3269 hours, or 65 per cent of the time for the entire course. It should be said, however, in regard to this classification, that it is somewhat arbitrary and the ratio is obtained by assuming that whatever time is left from the general studies the student devotes to drawing. In the majority of cases this is probably a true assumption, still, as is hereafter explained, the student is not bound to any certain number of hours for drawing but to a certain amount of work, and many students will get through much quicker and easier than others.

The study of construction is included under the various heads of materials, working-drawings, iron-construction, etc. These topics are handled entirely by Prof. Clark in the shape of lectures. In addition to the lectures, the classes are taken out to inspect buildings in process of erection, although this exercise is purely voluntary, and the classes being so large it is difficult to get the utmost good from such opportunities. In the lecture on working-drawings Prof. Clark has to assist him a set of detailed and full-size drawings, which have been prepared for the purpose, illustrating the different forms of ordinary wood and masonry construction. The students are required to prepare one drawing a week illustrating definite and practical problems; and, in addition, there is one lecture a week on variations in local practice. Besides this, the class, as a whole, is required to prepare and draw out an entire set of framing plans for some rather extended building. The subject of piling, foundations, etc., is taken up in the form of lectures, with two or three hours a week devoted to architectural problems and calculations.

It will be seen that, with the single exception of mechanical drawing in the first year, there is no drawing, as such, taught in the architectural department. There is, however, considerable practice in drawing, which, of necessity, forms a part of the other studies. The drawing mentioned in the first term of the second year is taken in connection with the study of the orders. All of the students are required to have a copy of Vignola and the orders are drawn out using it as a reference, the size of the module being given by the professor. The students are required to prepare one or two plates every week, and are given a pretty thorough drill in the orders. The "elements of architecture" refer to the studies of proportions of building, generally involving also studies of the orders, and the drawings are made from copies. The study of shades, shadow, and perspective is also properly drawing, although only incidentally so, the theory and practice of perspective being considered purely with reference to architectural drawings. Sketching, noted during the second term of the second year, is optional with the student, and is designed to be entirely outdoor work. During the third and fourth year the student has considerable practice in sketching and water-color drawing. The classes are under the direction of Mr. Ross Turner, and are allowed two hours each week, this being supplemented by occasional sketching trips during pleasant weather. Another study, which implies considerable

drawing, is classified in the catalogue as "lectures on fine art." This is merely a name to designate a number of different features introduced into the department from year to year. At present it consists of exercises in rendering in pen-and-ink. Each student is given a sheet of drawing-paper on which is printed, in very pale ink, an outline of some simple building, and one or two hours, according to the problem, is allowed for simply rendering the drawing. This exercise is under the direction of Mr. D. A. Gregg, It extends through the year.

Original designing is begun in the second term of the second year. The first problems are, necessarily, very simple in their nature, generally limited to portions of buildings, such as a porch, a portico, dormers, etc. The practice in designing is continued through all the rest of the course, the nature of the problems being graduated to suit the capabilities of the classes. The students' work is judged by various architects from Boston and vicinity, who are appointed by a regular committee of the Boston Society of Architects. In order to develop the individual possibilities of the student, the same system is used at the Institute that is in vogue at the School of Fine Arts in Paris. Every month three days are given to the preparation of a sketch in accordance with a programme which is posted up in the drawing-room. The students are allowed one month in which to develop the sketch into finished drawings, adherence to the original scheme being obligatory. The final drawings are required to be handed in very promptly. If the student is behind time he is allowed twenty-four hours in which to make up, but is only allowed half the credits he might have gained on that particular problem. A few of the actual problems may be of interest in this connection and will illustrate the style of work which the students are required to follow.

A Park Entrance. — "The principal entrance into a large park leads directly into the grounds from an avenue which runs along one side. The building over the entrance is not more than ten or fifteen feet deep, and consists of three equal arches ten feet wide in clear for carriages, with rooms on each side for keepers, police, etc. The space on each side of the archways is the same as the distance between centres of the arches, thus making five equal divisions of the building. The surface above the arches is treated with an attic and suitable figures, giving a good sky-line. On each side of the main building are entrances for people on foot, these entrances to be covered or not as chosen. All the entrances are to be closed with iron gates, and an iron fence or stone wall placed around the park. Design of gates must be shown. Required: sketch-plan and elevation $\frac{1}{16}$ inch scale. Finished design the same, $\frac{1}{4}$ inch scale."

This problem was for the second year. The following was for the third year:

A Gardener's Cottage. — "This little, one-story stone house, is supposed to be built by a gentleman, for his gardener, in the neighborhood of his garden. It will contain, below stairs, veranda on one side of the house, vestibule, stairs, two rooms, viz., sitting-room and kitchen, supplied with closets. The front door opens into the sitting-room, the back door into kitchen. Also an open shed for washing, with tool-room and water-closet. Up stairs are to be managed a chamber and two bed-rooms, these rooms to be located in the roof, lighted by large dormers. Required: 2 elevation $\frac{1}{8}$ inch scale, 2 plans $\frac{1}{16}$ inch scale."

In teaching the history of architecture, Fergusson is used as a text-book. The recitations are from about one-third of the chapters in the book and are supplemented by lectures and illustrations or lantern slides. The history of architecture is at present, taught by Mr. Homer. The study designated in the fourth year as "history of ornament," consists of lectures by Mr. C. Howard Walker, architect, of Boston. These occur twice a month, and are supplemented by plates drawn out and colored as directed for special problems every intervening week. During the last term of the fourth year considerable attention is paid to the subject of planning. There are lectures by Professor Clark, on the history of planning, and special study of house-planning with reference to domestic work, comparison with foreign examples, etc. At the same time, schools, theatres, churches and public buildings are considered separately and illustrated by the best available examples. The study of specifications is taken up in connection with Professor Clark's work on "*Building Superintendence.*" Heating and ventilation is taught quite thoroughly in theory, in the physical department of the Institute, and does not come under the actual charge of the teachers of architecture. It is illustrated by inspection of actual examples in the city theatres and school-houses. Stereotomy is also an outside study comprising drawing exercises from plates of definite problems.

The architectural department does not now make in the course any attempt at shop-work, except the tests of materials in the course in "applied mechanics." The Institute has unusual facilities for mechanical engineering practice, but none for just such work as Professor Clark would wish to make a part of the architectural course, except what is done on the testing-machine. Vacation work is not required of the students. The entire school year comprises thirty weeks. There is, consequently, a very long vacation in the summer, and students are encouraged to enter offices, whenever possible, and obtain practical acquaintance with architecture.

The architectural department occupies the greater portion of the second floor of the new building of the Institute, at the corner of Clarendon and Boylston streets. There is a large drawing-room with space for about seventy desks. There is also another drawing-room, fitted up with fourteen desks which are reserved for advanced students and those working for a degree. Opening directly from the main drawing-room is the department library comprising six hundred and fifty volumes, and some three thousand photographs bound in books. The library and photographs are entirely free to the students, who are encouraged to use the collections very freely. There is, also, quite a collection of casts and models of architectural fragments, and a very fine lot of French school drawings, including some of the *Envois de Rome*, which were secured by Professor Ware, some years since, in Paris.

In addition to the special library, several thousand photographs, prints, drawings, and casts have been collected to form a nucleus for an architectural museum, by means of a special fund raised for the purpose. To these collections large additions have been made, mostly by gifts. Models and illustrations of architectural detail and materials are arranged in the rooms of the department, but the chief part of the collection of casts of architectural sculpture and detail belonging to the department has been, for want of space in the Institute buildings, deposited in the Museum of Fine Arts, together with the architectural collections belonging to the Museum. The students of the department have free access to them at all times; and as the Museum building is close at hand, no inconvenience results from the change.

To be admitted as a regular student in the first-year class, the applicant must have attained the age of seventeen years, and must pass a satisfactory examination in arithmetic, algebra, plane geometry, French, English grammar and composition, history and geography. To be admitted as a regular student in either the second, third or fourth years, the applicant for this advanced standing must have attained the proper age (eighteen, nineteen, and twenty years respectively), must in general pass satisfactorily the examination for admission to the first-year class, and examinations on all of the subjects given in the earlier years of the course which he desires to enter. Graduates of colleges are admitted to the Institute without examination, and will be permitted to enter any of the courses at such a point as their previous range of studies shall allow.

The number of regular students last year in the department of architecture was seventeen; the special students numbered forty-eight, making a total of sixty-five. This does not include the students in the preliminary year, who are not classified in any department. Of the regular students, three were from Boston, eleven from New England, one from the Eastern States, and two from the West. Of the specials, eleven were from Boston, twelve were from New England, eleven from the Eastern States, and fourteen from the West. As previously stated, the first graduation from the department was in 1873. The single student who obtained a degree at that time, is noted in the catalogue as having abandoned the study of architecture, and being employed on the Fitchburg Railroad. Since 1873 there have been twenty-two graduates in the regular course, an average of one and seven-fifteenths per year. Of these twenty-two graduates, eight have abandoned the profession entirely, seven are employed as draughtsmen in architects' offices, and the remaining seven are practising architects. Of the fourteen graduates from the regular course who remained in the profession of architecture, nine are resident in Boston, one more in New England, three in the Eastern States, and one in the West. These figures, of course, include only the regular students. It is impossible to get at any satisfactory idea of the number of specials, but as many of the special students pursue the course only in a tentative spirit, it is fair to assume that the total number who have left the school after having pursued the special course, is not over fifty or sixty.

The degree of Bachelor of Science is conferred upon the students in the regular course who pass satisfactory examinations in the prescribed studies and in addition presents a satisfactory original design accompanied by an explanatory memoir.

Every student is required, on entering the school, to file with the bursar a bond in the sum of two hundred dollars, signed by two responsible sureties, one of whom must be a citizen of the United States, as security for the payment of all bills of the Massachusetts Institute of Technology. If, for any reason, such a bond cannot be obtained, a deposit of fifty dollars, as security, will be accepted. No officer of instruction, or student of the Institute will be received as surety.

The tuition-fee for regular students is $200 per year, and must be paid in advance as follows: $125 on or before October 10, and $75 on or before February 10. For one-half or any less fraction of a school year, the fee is $125. Payment is also required of the cost of apparatus injured or destroyed in laboratories. Special students pay, in general, the full fee; but when a few branches only are pursued, and the time required for instruction is limited, some deduction may be made. The fee for students in the advanced courses is the same as for regular students. The total cost for attendance at the Institute during four years is, therefore, as follows, exclusive of expenses during vacation, and all personal expenses: —

Tuition.	$800
Books and material.	190
Board and Room at $8 per week.	960
Total.	$1900

It would be difficult to accomplish the course at less cost than this, and we fancy the majority of students spend much more.

The Boston Society of Architects has founded two prizes of $50

each, to be given in books to the student who, during the year, shows the greatest improvement in design, and also to the one who makes the most marked progress in construction. There are scholarships open to regular students in the Institute, but they are mostly for students who have entered the Institute under certain conditions, and the architectural department seldom profits by them. By the bequest of the late Richard Perkins, the income of $50,000 is to be applied to the creating of additional scholarships, all of which will be open to students of the department.

ON ARCHITECTURAL MATTERS IN SWEDEN.

Tower at Leyden. From Architektonische Rundschau.

WHEN a country is developing under generally good conditions of social ease and good political terms with its neighbors there is every prospect of progress in art generally and in the art of architecture especially. This is at present the case with Sweden. This country, however, is by its remote situation and its small size generally only little known to the outside world. It is off the ordinary route of commerce and far from the political centre of Europe, but yet is a country that has for seventy years been at perfect political ease and consequently has had time to develop all its natural forces and pay all possible attention to domestic matters, to industry, agriculture and building. It is more and more visited by strangers, which shows that the attention it attracts from the outside world is increasing and that people want not only to know the country by hearsay, but to see it and make their own investigations. As proof of progress it may be mentioned that it has, during the last decade, enlarged and beautified its cities to a good extent, especially its capital, where a great building boom has prevailed these several years.

Sweden has not always been of its present size. There was a time when it deserved a place at the side of the great powers. It had defeated Germany and other powers after many and long-lasting wars, and from the beginning of the seventeenth to the beginning of the eighteenth century it held possessions all around the Baltic Sea from some northern parts of Prussia up to and including Finland. During that century immense wealth was brought into the country, which led to an amount of building that surpassed that of any other time in the history of the country. Strongholds, castles and churches were erected in a most solid way, and many fine examples of architecture of this past time worthy of attention are still left. There is a little island in the Baltic Sea called Gotland, which, singularly enough, was at that time quite inundated with new buildings of all kinds. The cause of this was its abundance of the best of building materials, its splendid southerly climate, which is rather different from that of the continent, and its location, as all the merchandise from the East had to pass this way over to the Continent, and so kept up business and made the small place progressive. The architecture of the place, although showing German influence, acquired a character of its own, and consequently this is the only part of the country that has in any marked degree been the object of special studies by foreign experts, especially Englishmen.

When viewing any large city, we must always bear in mind that the general look of the whole is not only dependent on the plans and designs delivered by the architects, but in a most remarkable degree on the building-law and on the laying-out of the streets. The architect has often a hard task in trying to make "something nice" when squeezed within a very limited space by more or less ingenious prescriptions of a building-law. It is true that a city building must generally be of a character different from that of a country house. It gets a character of calmness, earnestness and regularity, while the country house, the big castle or the small cottage, which do not know any laws of erection, necessarily create a lively and somewhat attractive impression merely by their well-detached masses, even if the architecture be defective.

Sweden has one building-law common to all cities and towns, giving rules of general character, besides an especial law for each on account of differing wants, while the capital has one still more specific and detailed. The present building-laws of Sweden, though, leave much to desire and are likely to be submitted in the near future to some changes to better meet the demands of the present time. For instance, the height of all buildings is very limited, always depending on the width of the street, but never exceeds five stories. Still, allowance can be made for important private or public buildings which are to be built free on all sides.

The interests of sanitation are generally well provided for. For instance, large yards are prescribed and building is not allowed on more than two-thirds of the whole site, the surface of the yard must not be less than 1900 square feet, and the main part of the same not less than forty feet in width. Light-shafts are not allowed of any shape or size whatever in the new part of the city, but can, under certain circumstances, be allowed in some of the old parts. Concerning the roof and its construction many limitations are made by the law. The pitch of the roof is not allowed to be more than two-fifths of the width of the part of the building it covers, and the mansard roof is not allowed on dwelling houses. All drawings must be filed in the Building Department and in the Health Department, and all building is supervised by inspectors from these departments.

In Stockholm the building-lots are generally very expensive, and that causes the owners always to erect their buildings as high as the law allows. Consequently, the cornices of all buildings form almost one continuous line, which is almost as bad looking as the too great differences in height of buildings to be seen in New York and other cities of this country. An owner of a building or a tenant never occupies the whole house for himself, but merely one story, consisting of six to twelve rooms according to different circumstances.

The tenement-houses are generally well arranged, at least those erected during the last decade, and give in many cases real comfort to the lower class of people, who have been benefited greatly by the recent progress in building. There are several kitchens on each floor, with two or three rooms belonging to each.

The shapes of building-lots are varied, of course, but in new parts of the city tend to squareness. There are never to be seen lots so narrow at the front as often in cities here, which afford space for only three windows, which seem almost to be the regular width of the American city dwelling-houses.

The buildings are generally erected in a careful and solid way with especial regard to keeping the houses warm and comfortable during the cold season. Still, during the winter time it is very seldom, if ever, so cold as it is here. The windows are well planned to keep the cold out. So-called French windows are always used, with a post in the middle, and the both halves opening outwards. In winter time two sets of window-sashes are used, put about three inches apart, the window-frames being so constructed as to make it easy to fix a loose set of sashes to the inner side of the frame. It was very much the fashion some time ago to have all the rooms in one line in order to give a nice perspective view of the rooms from one end to the other, but now this idea has been more and more abandoned, and the fashion is to have the rooms centred around the hall, from which it is desirable to have entrance to as many rooms as possible.

A special feature of each room is the brick stove, which has nearly the same height as the room itself. They are built up of bricks of a certain size and of plain or moulded pieces of burnt clay of a special kind, which are polished and glazed on the surface, and also of many different colors. The design of the whole is sometimes treated very decoratively, and therefore these stoves are often found very costly, but are also truly considered as a real ornament in the room.

To reach the upper stories, one has always to use the stairs, as elevators are with few exceptions not used, but instead the stairs are constructed with a considerable width, and much attention is generally paid to the arrangement of the hall and staircase together to give it plenty of light and air.

Nature favors builders with an abundant supply of the best of building stones, good clay for artificial stone and terra-cotta, while the large forests furnish the best kinds of timber, of any desirable size. Granite is exclusively used for foundations and main doorways, and also, although seldom, as face-stone. Limestone and sandstone are more used as facing for buildings, as mouldings, ornaments, and window-frames. The Island of Gotland is almost entirely one big rock of sand and lime stone.

The country does not supply the whole amount of face-brick, wanted for building. A good deal is imported from Germany. And terra-cotta is only sparingly used strange to say — strange, because there is an abundance of good clay over the whole country but the activity in raising that industry has as yet been very slow.

More used in building is cement, the making and moulding of which has been greatly improved during the last years. Not only for mouldings and ornaments, but for floors, window-frames, steps and stairways, made in whole blocks, it is in common use and is very often ornamented in color and polished, which gives a smooth and nice-looking surface.

The cost of common brick is eight dollars and upwards per thousand, and of first-class face-brick, twenty-five to thirty dollars. The average contractor usually counts for common good brickwork, laid in lime-mortar, twenty cents per cubic foot. The workingman gets paid both by time or by contract, the former way always when there is to be taken especial care in the erection of a building. A good bricklayer then earns about $1.75 a day. In making contract he usually gets from $4.00 to $7.00 for the work of putting 1000 brick into the wall.

The architectural training in Sweden is on a good standing. Most of the architects are thoroughly trained, not only having spent many years of study at the schools and university of architecture at home but abroad in Italy, France or Germany, and are generally well-prepared for their practice before starting. At the schools more stress is generally laid on teaching of matters of styles and the æsthetical part of architecture than to matters of construction.

The charges of the architect are generally different for different kinds of work, but on an average three per cent of the cost of building.

In speaking of architectural matters we ought to mention the king's palace at Stockholm, although begun in the last century, and completed in the beginning of this century. It was built by Tessin, undoubtedly one of the most prominent artists of his age, even compared with those of other countries. The vast structure makes a rich and grand impression, and is considered one of the most beautiful in the world, by its situation with plenty of surrounding water, its majestic extent, and by the harmony of all its different parts.

During this decade building has been carried out on a great scale in all the larger cities, and especially in Stockholm, and in all buildings have generally been used all improvements of our time in order to make structures solid and life comfortable, while the elevations show good and carefully-studied work. Martin Borgstedt.

THE ILLUSTRATIONS

[*Contributors are requested to send with their drawings full and adequate descriptions of the buildings, including a statement of cost.*]

HOUSE OF E. V. R. THAYER, ESQ., LANCASTER, MASS. MESSRS. ANDREWS & JAQUES, ARCHITECTS, BOSTON, MASS.

[Gelatine Print, issued only with the Imperial Edition.]

LADIES' HALL, LAWRENCE UNIVERSITY, APPLETON, WIS. MR. WARREN H. HAYES, ARCHITECT, MINNEAPOLIS, MINN.

This building is to cost $25,000.

ENTRANCE TO BISHOP'S PALACE, SENS, FRANCE. — DETAILS OF CEILINGS AT BOURGES AND EVREUX, FRANCE. DRAWN BY MR. J. A. SCHWEINFURTH, ARCHITECT, BOSTON, MASS.

These illustrations are reproduced from "*Sketches Abroad.*"

MAIN HALL, IN "ROCKWOOD HALL," TARRYTOWN-ON-HUDSON, FOR W. ROCKEFELLER, ESQ., N. Y. MESSRS. CARRERE & HASTINGS, ARCHITECTS, NEW YORK, N. Y.

Hall in quartered oak, marble mosaic floor, modelled ceiling and marble stairs. This work in a slightly modified form is now being built.

THE ROYAL LIBRARY. — THE OLD HOUSE OF LORDS. — THE NATIONAL MUSEUM AND ST. CATHERINES CHURCH, STOCKHOLM, SWEDEN.

HOUSE BUILT IN CONNECTICUT, IN 1880. MR. C. E. CASSELL, ARCHITECT, BALTIMORE, MD.

SOME OBSERVATIONS ON THE HYGROMETRIC BEHAVIOR OF CERTAIN WOODS.

These experiments consisted of observing the changes in weights of a number of samples of kiln-dried woods which took place upon their exposure to comparatively slight changes in atmospheric conditions.

The following kinds of woods were used:

Wood.	Dimension.	Weight.	Specific gravity.
	Inches.	Grammes.	
Whitewood	1.97 × .76 × 1.58	19.5395	.5072
Liriodendron tulipifera			
White pine	1.47 × .86 × 1.67	17.4786	.5052
Black walnut	1.48 × .90 × 2.00	28.3955	.6504
Cherry	1.50 × 1.00 × 2.00	26.1479	.5318

Several weeks prior to weighing the samples were kept in a dry, well-ventilated building.

The air of the room in which the samples had been kept was evidently somewhat dryer than in the balance-room, which is shown by the cherry sample immediately gaining in weight as soon as placed upon the balances. The other samples were not examined in so great detail, although the same behavior was shown by each after a greater interval of time had elapsed.

DETAILS OF THE WEIGHINGS.

WHITEWOOD.

No.	Interval of time.	Successive gain.	Total gain.	Remarks.
	H. M.	Grammes.	Grammes.	
1	.. ..	..	..	
2	2 22	.0105	.0105	
3	1 37	.0052	.0157	
4	3 8	—.0072	.0085	
5	16 32	.0396	.0481	After resting over night.
6	3 48	.0092	.0773	
7	23 58	.1708	.2481	After remaining one day on ground floor of building.
8	4 5	8.4924	8.7405	Submerged in boiling water twenty minutes.

WHITE PINE.

No.	Interval of time.	Successive gain.	Total gain.	Remarks.
	H. M.	Grammes.	Grammes.	
1	.. ..	..	..	
2	1 27	.0110	.0110	
3	1 42	.0076	.0186	
4	3 7	—.0078	.0108	
5	16 34	.0766	.0874	After resting over night.
6	3 40	.0033	.0907	
7	24 ..	.1673	.2580	After remaining one day on ground floor of building.
8	4 1	15.4034	15.6614	Submerged in boiling water twenty minutes.

BLACK WALNUT.

No.	Interval of time.	Successive gain.	Total gain.	Remarks.
	H. M.	Grammes.	Grammes.	
1	.. ..	..	..	
2	2 25	.0087	.0087	
3	1 42	.0048	.0135	
4	3 9	—.0066	.0069	
5	16 30	.0586	.0655	After resting over night.
6	3 46	.0090	.0745	
7	23 58	.1706	.2451	After remaining one day on ground floor of building.
8	4 6	4.7194	4.9645	Submerged in boiling water twenty minutes.

CHERRY.

No.	Interval of time.	Successive gain.	Total gain.	Remarks.
	H. M.	Grammes.	Grammes.	
1	.. ..	..	..	
2	.. 5	.0029	.0029	
3	.. 5	.0018	.0047	
4	.. 5	.0020	.0067	
5	1 20	.0214	.0281	
6	2 55	.0215	.0496	
7	1 ..	.0351	.0847	One hour on ground floor of building.
8	.. 20	—.0026	.0821	In balance-room.
9	.. 30	—.1450	—.0629	Exposed to air outside the building in direct rays of sun.
10	1 10	.0495	—.0134	In balance-room.
11	.. 7	.0080	—.0054	On ground floor.
12	.. 8	.0020	—.0034	In balance-room, exposed to sun's rays, window closed.
13	13 35	—.0590	—.0624	After resting over night in building where originally kept.
14	.. 32	.0110	—.0514	In balance-room.
15	1 43	.0198	—.0316	
16	3 8	.0005	—.0311	
17	16 30	.0964	.0653	After resting over night.
18	3 40	.0084	.0737	
19	23 59	.1910	.2647	After remaining one day on ground floor of building.
20	4 5	33.5974	33.8621	Submerged in boiling water twenty minutes.

In the first table the dimensions are given in the order of width, thickness and length for each sample: their weights as first taken and specific gravities computed therefrom.

In the tabulations of the details of the weighings are given the intervals of time between each weighing and the gain or loss in weight. Losses are indicated by minus signs, and in the column of remarks, what treatment the samples had been subjected to. It will be understood that the samples remained in the balance-room after weighing began, unless stated otherwise.

The treatment of the cherry wood was, after the fourteenth weighing, substantially the same as of the others after the second weighing.

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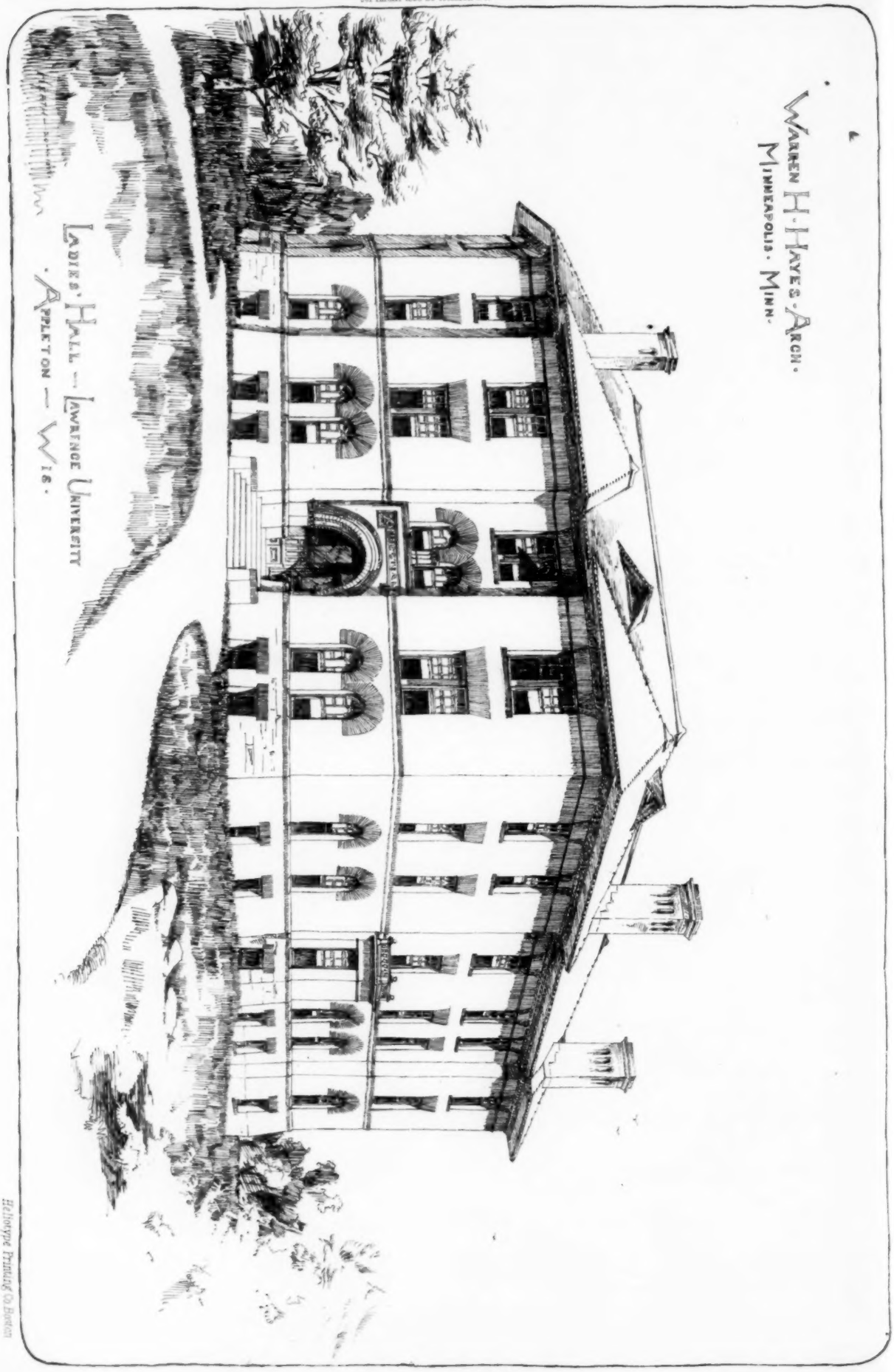

LADIES' HALL — LAWRENCE UNIVERSITY
APPLETON — WIS.

WARREN H. HAYES, ARCH.
MINNEAPOLIS, MINN.

Heliotype Printing Co. Boston

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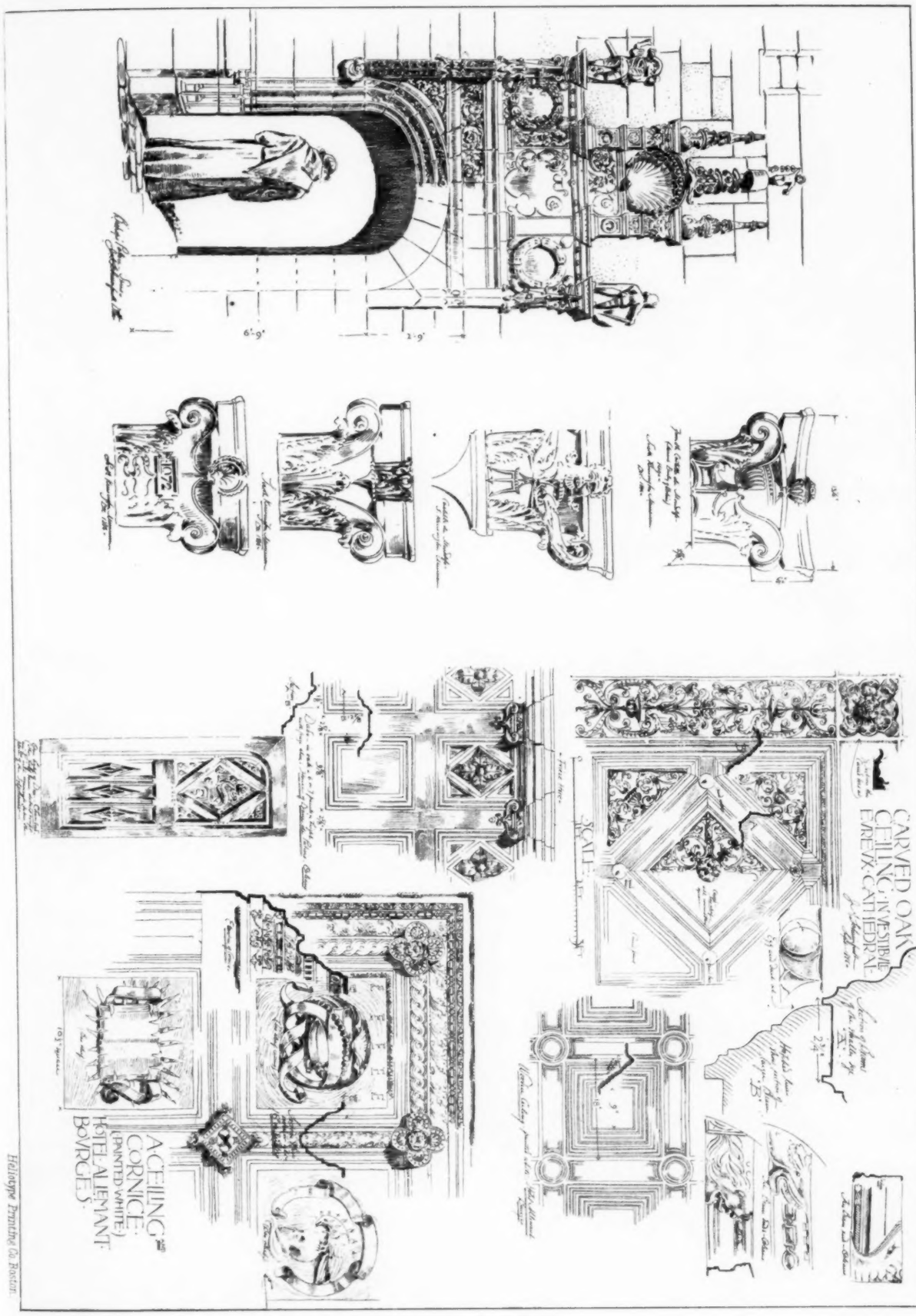

Heliotype Printing Co. Boston.

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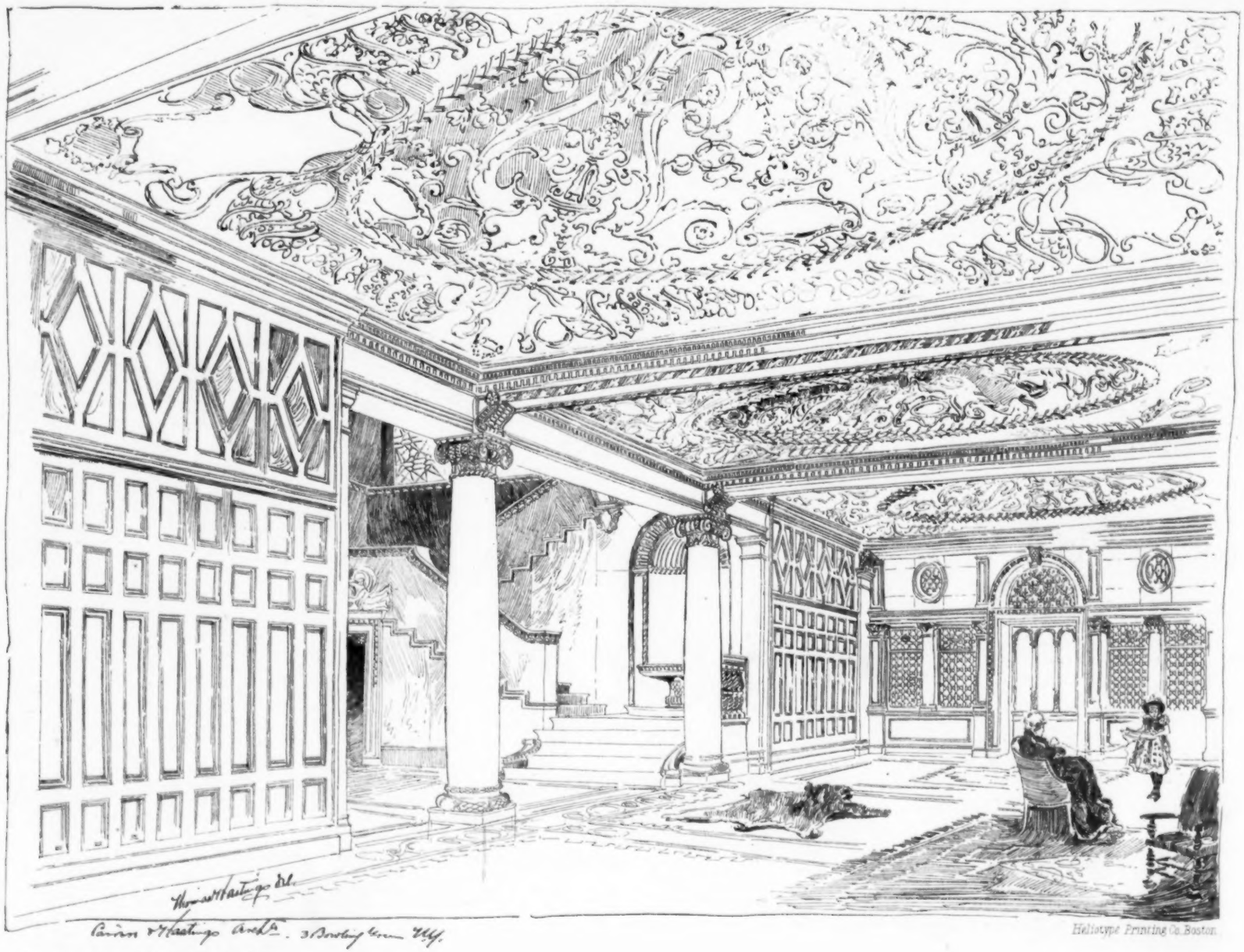

Perspective Sketch of Hall:
House of Mr Wm Rockefeller

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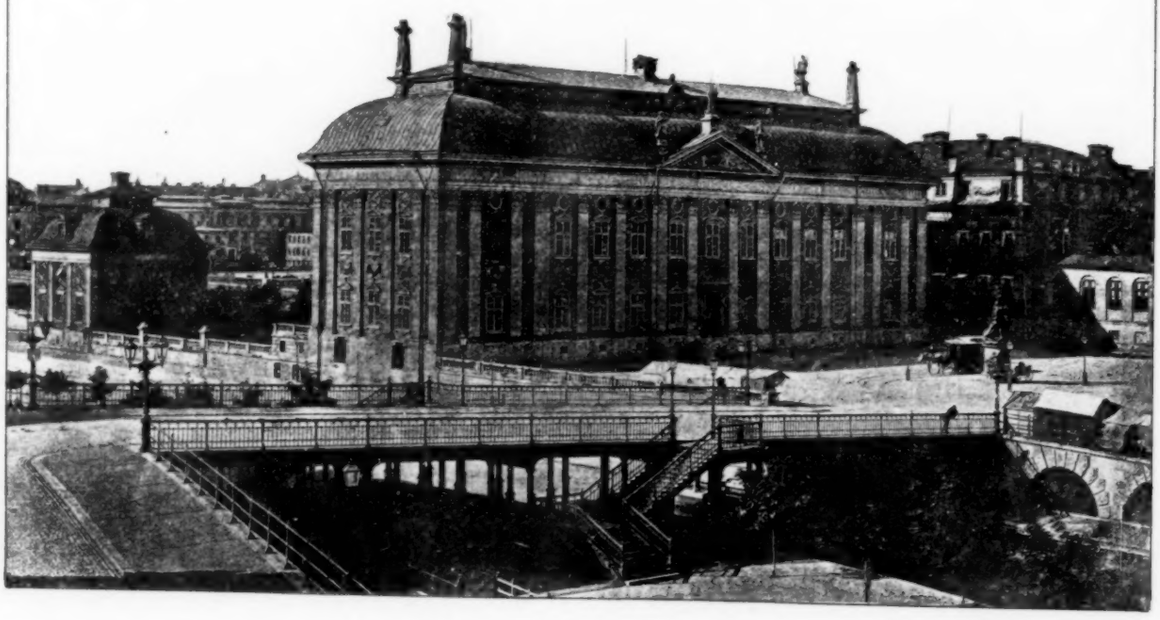
St. Catherine's Church, Stockholm.



The Old House of Lords, Stockholm.

Heliotype Printing Co. Boston

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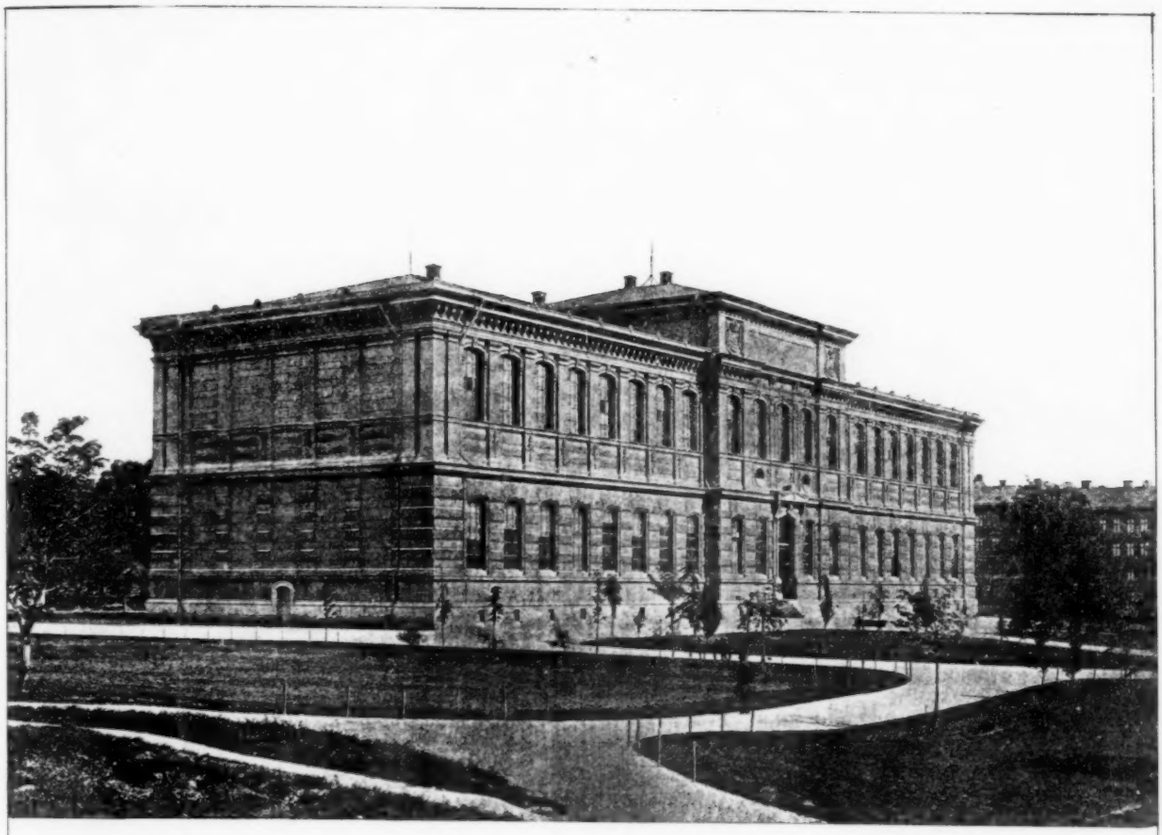
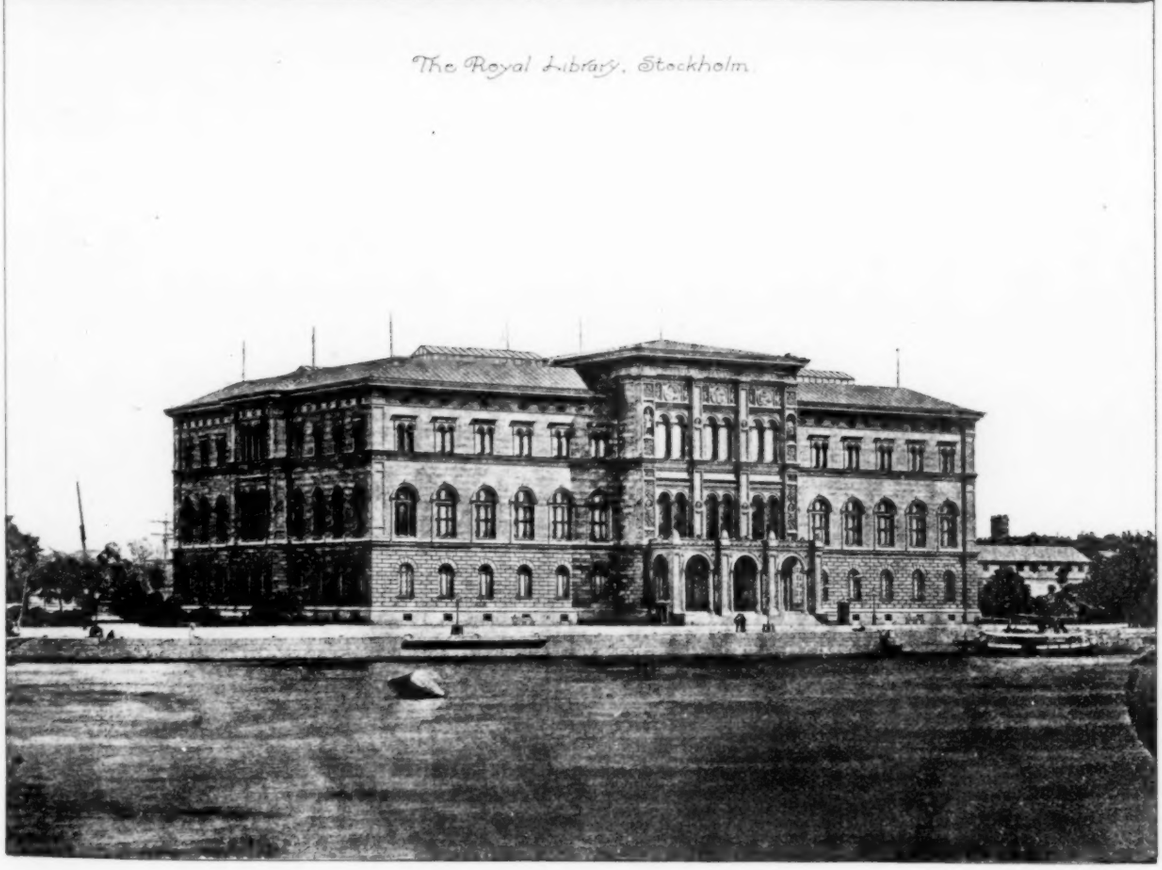


The Royal Library, Stockholm.



Heliotype Printing Co. Boston

The National Museum, Stockholm.

House built in Connecticut in the year 1880.

S.E. Mon

Chas E. Cassell. Archt.
Delta Md

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House built in Connecticut in the year 1880.

S. E. Mon.

Chas F. Cassell Archt.
Boston Mass.

During the interval between the last two weighings, the samples were submerged in boiling-water where they were kept twenty minutes, the water was then cooled to about eighty degrees Fahrenheit, the samples removed and immediately weighed.

The first three samples behaved very much alike in the early weighings, also the cherry for corresponding weighings, but the several woods differed in the degree to which they were affected.

The whitewood, white pine and black walnut at first gained in weight then lost slightly, gained over night and during the following day. The loss occurred in the afternoon. Taken to the ground-floor of the same building and there kept one day, and there was a greater increase than before.

Up to this time the actual gain was about the same in each sample, although in per cent the walnut had gained the least, on account of its higher specific gravity.

After submersion a radical difference was found, the walnut gained the least, the whitewood had gained nearly twice as much as the walnut, and the pine gained nearly twice as much as the whitewood.

This was explained when the samples were split longitudinally, the water had penetrated the walnut endwise to a depth of only .15″, the whitewood to a depth of .22″, and the pine to a depth of .45″.

The cherry sample was weighed at frequent intervals when first placed on the balances. It gained rapidly in weight, but at a diminishing rate as it approached the limit of saturation in that atmosphere, but when, however, it was removed to the ground-floor of the building, a somewhat damper atmosphere prevailing, it again gained rapidly. Returned to the balance-room and there was loss in weight. Exposed to the sun's rays and a dry brisk wind and there was a large loss exceeding the total gain thus far observed. A few changes in location were then made, each producing results in accordance with previous experience. So sensitive was this wood to change in weight that it would seem quite possible to accurately tell where the sample had been taken to if removed from the balance-room to other parts of the building, or to the outside air and returned again to the balance-room. In some buildings the difference in the relative dampness of the several floors might be shown.

After the twelfth weighing the cherry sample was taken to the building in which originally kept, and there remained over night, during which time there was a loss of 590 mg.

Notwithstanding there was a shower of rain in the meantime, the relative humidity of the atmosphere ranged from 52 to 64 per cent, the thermometer indicating from 70 to 84 degrees Fahrenheit during the days these experiments were in progress.

After submersion this sample was found to have gained the total of 33.8621 grammes, or more than its original weight. It is seen that the present weight exceeds an equal volume of water.

When split longitudinally every part of the wood seemed to have been wet, the penetration or moisture was apparently complete.

The description of these tests have been given somewhat minutely, in order to clearly indicate what changes go on in a brief space of time, and without large changes of atmospheric conditions. Were the observations extended over a longer period, or from season to season, greater differences in weights would be expected.

The amount of moisture absorbed under ordinary circumstances seems to depend upon the amount of surface accessible to the air, of which surface the outside parts of the sample form only a limited portion.

A specimen might have low specific gravity, and actually contain only a small amount of woody fibre, yet its structure be such as to prevent the free circulation of air through it, and, therefore, not expose much surface on which condensation may take place.

In the tests, we see the cherry-wood, low in specific gravity, it is true for its kind of wood, absorbing moisture at a more rapid rate than the softer whitewood and pine samples, and further the denser walnut bearing a very close resemblance to the whitewood up to the time of submersion in boiling-water.

Not enough is shown at this time to say whether the woods bear the same relation to each other in regard to imparting their moisture as in absorbing the same.

Closely allied to the subject of the absortion of moisture is the subject of expansion and contraction, or, as generally spoken of, the shrinking and swelling of wood.

It may be inferred that the amount of moisture absorbed will not always be correctly indicated by the swelling of the wood.

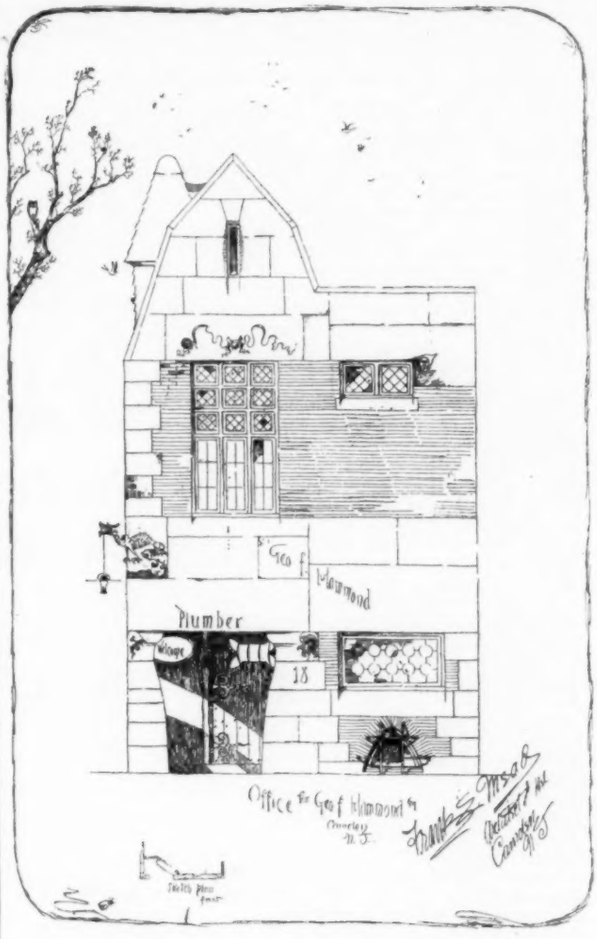
The impression seems to hold among woodworkers that cherry retains its shape rather better than whitewood, or in the reverse order of their rates of absorption here shown.

The relative expansion of wood and its elasticity in a transverse direction is an important question.

Where it is essential to maintain close joints, such information would enable us to say whether it were possible or not to secure this end with certain kinds of wood, and if it were possible then to ascertain what lateral compression would be necessary to hold the wood in place. Obviously the range in elastic movement under lateral compressive stresses must be greater than the range in movement due to shrinking and swelling, to make it possible to keep the joints together at all times.

J. E. HOWARD.

THE SUBWAY PROBLEM IN GREAT BRITAIN.



IN all that follows it is well to remember that all wires except the telephone are "in a circuit." One wire will operate a great many telegraph instruments, electric-lights, "tickers," or messenger-calls, but, practically, every one of the 700 telephones in use in New York city has its separate wire. In New York we have doubtless 30,000 miles of wire, of which eighty per cent are telephone conductors. In London, with four times our population, there are not over 19,000 miles of wire, of which 11,000 miles are telegraph wires and 7,000, or thirty-seven per cent, telephone. Of the former but 868 miles are above the ground. Of the 7,000 miles of telephone wires in London all are overhead, excepting those operated as private lines by the Post-Office Department, which are underground in the same conduits as the telegraph. In the whole of the United Kingdom there were last year about 27,000 miles of telegraph wire, of which about 20,000 miles, seventy-four per cent, are underground. Comparing New York with London, the first striking difference we notice is in the relative proportion of telephone to telegraph wires. This must be remembered, for it constitutes the chief difference in the underground problem as between the two cities. The telephone in England, comparatively speaking, is still a luxury, electric messenger-service is practically unknown, and electric street-lighting in embryo.

On the Continent the Government has, as a rule, been more liberal to the telephone interests. Comparing Stockholm and Edinburgh, for instance, each with about the same number of inhabitants, we find that while in the former there are over 5,000 subscribers to the *Telephone Exchange*, in the latter there are about 400. On January 1, 1886, there were about 353,518 telephone receivers and transmitters in use in the United States under license from the Bell Company. In Great Britain there were on the same date 184 exchanges with 19,784 subscribers. As has already been intimated, little has been done in London towards the burying of any wires except those of the telegraph proper.

It will be interesting to compare the relative demands of telegraph service in the two cities. The Associated Press despatches from New York are said to *average* daily over Western Union wires alone 2,600,000 words. The *maximum* newspaper work reported by the Government telegraph authorities in London was, on the day of Gladstone's great speech on home rule, April 18, 1886, 1,050,000 words. The day the Emperor William died, by the way, there were sent off from the Berlin telegraph office 29,878 messages, aggregating

799,926 words. On the following day this record was beaten with 36,615 messages, aggregating 1,115,551 words.

In addition to the electric telegraph, there are in London thirty-two miles of pneumatic-service tubes, the longest being between the House of Commons and the Post-Office (3,859 yards), carrying 700 messages daily at a speed of six minutes, similar to those of the Western Union here.

While the telegraph wires of London are so largely underground, there are some who attribute the slow growth of arc-lighting in England to the act of Parliament requiring the electric-light wires to be buried. The difficulty presented in the transmission of electrical vibrations over a wire, whether above or below the earth's surface, varies, of course, with the strength and character of the current employed. In the arc-light current, at one extreme, we have an intensity capable of producing instant death like the lightning stroke, of fusing metals, and instantly setting fire to any combustible matter. At the other extreme stands the telephone. It has been demonstrated "that the strength of the electrical current produced by an ordinary telephone in use as a transmitter is less than that which would be generated by a single battery-cell through a line of ordinary telegraph wire 6,000,000 miles in length, and the strongest current produced by such a telephone is only four hundred-thousandths as strong as that used on a telegraph line, while a current one-millionth as strong as the ordinary telegraph current will give distinct, audible articulation."

Two facts are apparent from our brief comparison:

(1) Successful underground electrical service is to-day in London chiefly a question of telegraphy, while in New York it is chiefly one of successful telephony.

(2) The methods and experience of London, whatever we shall find them to be, cannot be taken as an infallible guide for our New York conditions.

In spite of the unquestioned attendant drawbacks, I shall take it for granted that no one here still honestly persists in believing that successful underground service is *impossible* even for the telephone, while we need not go so far as Preece, the chief Government electrician in England, who recently said in public: "The Postmaster-General has now under his consideration a scheme for using underground wires more extensively," and added: "There is nothing whatever to prevent this being done by the telephone companies. In fact, in many cases telephones work better underground than overhead. The laws that govern the transmission of speech are now thoroughly known and the fancied difficulties in using the underground wires have vanished into thin air. In London alone we have 255 miles of pipes, containing 10,112 miles of wire. In fact, all our great trunk-lines are out of danger from stoppage from storms. There are 213 offices now served wholly by buried wires; we are steadily pursuing the same policy, and the overhead proportion as compared with the underground steadily diminishes."

In London and in Edinburgh, as in Brussels, Antwerp and other large Continental cities, the telephone wires are overhead, not, to be sure, in the streets, but, nevertheless, in the air; they are upon the house-tops. The telephone companies obtain permission from the owners of buildings to erect wooden or iron supports upon the roofs, and some of these carry over two hundred and fifty wires each. While this network of wires is visible from the streets when they cross over from block to block, they are neither in the way of firemen, nor in front of the windows of houses, nor are poles erected before one's door. Next to a subterranean system, this is by far the most satisfactory method of stringing wires, to the public at least. Then, too, in European cities, small copper or bronze wires are used instead of the larger iron conductors. In Paris the problem solved itself, for the electricians found the great system of sewers ready for them, and all the wires are strung upon their arches or sides, as accessible almost as if in the streets and requiring no "conduit" or other special structure; but where the sewer ends they come up out of the ground and continue on the house-tops.

Now, examining the London system, let us answer the practical American question, "How does it work?"

From the point of view of the practical electrician, the best and certainly the cheapest insulation in the world is dry air, and ideal electric service is sometimes most nearly attained on a clear winter's day with a naked, overhead copper wire. Compared with an overhead system even in the moist climate of England, Mr. Preece tells me that he considers the present iron-pipe, underground system sixteen times less efficient, *commercially*, or, as he put it, "Its cost is four times as great and its capacity one-fourth." Or, to put this in working figures: Between London and Edinburgh the distance is 390 miles. Between the two central telegraph offices thirteen miles of this distance are underground, while the remaining 377 miles are overhead. Between the points where the service is entirely overhead, they are able to send, by a rapid "multiplex" system, 600 words per minute, while from the actual termini, through thirteen miles of iron-pipe, only 150 words can be sent. Between London and Liverpool, 200 miles, Delany's multiplex works six ways from the overhead terminus, while from the central offices, partly underground, it works only four ways, that is, all overhead, 450 words per minute; partly through iron-pipes, 100 words per minute. This great loss in efficiency, be it remembered, is considered in connection with the telegraph conductors only. Under similar conditions it is but fair to suppose that long-distance telephonic communication at least would be almost impossible.

Mr. Preece frankly stated this objection to the iron-pipe system, and said that he "would welcome any change that offered possible improvement." The chief thing in favor of iron was "the protection against mechanical injury to the wire by laborers and its comparative cheapness." "Increasing the size of the conductor was of benefit, and some experiments with a large wire heavily insulated with Callender's 'bitite' and laid in asphalt, have given tests that were interesting and promised well when more fully tested by the Government."

The experience of London is that of nearly all the English cities: telephone and electric-light wires overhead, telegraph principally underground. Newcastle, however, is an exception. Here, at the very outset, the telephone company put all its wires below ground in the inevitable iron-pipe. There is but one central office, from which the wires radiate to the 700 or 800 subscribers, who are within three-quarters of a mile of the exchange. No. 16 and 18 copper-wires are used, quite heavily insulated and bunched in cables. The service is fair and there is small complaint. Other large cities are said to be on the point of burying telephone wires and have already put nearly all their telegraph wires underground.

However, the whole situation to-day in Europe, including Great Britain, may be summed up as follows:

Telephone service, overhead, small copper wires on neat standards upon house-tops, owners compensated for use of roof. Poles only allowed where roof service is impossible.

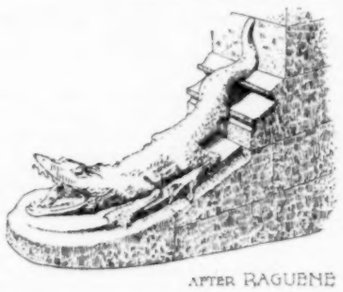
Telegraph service, largely underground in England and on house-tops elsewhere.

Electric (arc) light service practically all overhead.

And in conclusion it may be said that so complex and intricate a tangle as the subway problem in New York is not even dreamed of in Europe, much less solved. With our growing electric-light service, our district-messenger calls, and, above all, our great telephone system, with our network of gas and water and steam pipes in the the street, we have a problem that we must work out practically alone, unaided by European experiences. Radiating from our metropolis like the threads of a gigantic spider's web, including and connecting neighboring cities and growing towns and even distant cities, already there stretches a network of wires, along which throb the impulses of our commercial life. We think the problem of their location difficult to-day. What will it be when every man has a telephone in his house; when gas-light within, as well as without, gives way to the electric-light; when our streets must yield yet more room for fuel-gas pipes, larger water-mains, etc., etc., what shall then be done?

It needs but a brief glance ahead to see that our few iron-pipes or any other electric conduits must prove inadequate, and it requires no inspired prophet to predict that we must soon in New York come to the Paris system of sewers, cost what it may, at least on all main streets and avenues, wherein all our pipes and wires can be placed, and digging up the pavements cease.—*Albert R. Ledoux, in the N. Y. Evening Post.*

STONE FOOTING-COURSES.



AFTER RAGUENET

In arranging the footing-courses of walls and piers, it is frequently desirable to contract the area of the foundation as rapidly as possible. The method of doing this by the use of railroad-rails and steel I-beams has been presented recently in these columns. Although steel possesses superior advantages for this purpose, yet stone will continue, for obvious reasons, to be largely used for foundations, and hence it is desirable to know by what amount each footing-course may be narrower than the one next below it.

The amount of this off-set will be limited by the transverse strength of the stone. The part of the footing which projects beyond the course next above it resists as a beam fixed at one end and loaded uniformly. The load is the pressure on the earth or the course next below. The strength of such a course depends upon the amount of the pressure, the transverse strength of the material, the length of the projection, and the thickness of the course.

To deduce a formula for the relation between these quantities, let P = the pressure in tons per square foot at the bottom of the footing-course under consideration; R = the modulus of rupture of the material in pounds per square inch; p = the greatest possible projection of the footing-course in inches; t = the thickness of the footing-course in inches. From the principles of the resistance of material, we know that the upward pressure of the earth against the portion of the footing-course that projects beyond the course next above it *multiplied by* one-half of this projection *is equal to* the continued product of one-sixth of the modulus of rupture of the material, the breadth of the footing-course, and the square of the

thickness. Expressing this relation in the above nomenclature and reducing gives the formula:

$$p = t\sqrt{\frac{R}{41.6P}};$$

or, with sufficient accuracy,

$$p = \tfrac{1}{6}\, t\sqrt{\frac{R}{P}}.$$

The projection available with any given thickness, or the thickness required for any given projection, may easily be computed by the above relation. Notice that the off-set given by the above formula is the projection for which the stone would be on the point of breaking and not that which may be safely used.

The margin to be allowed for safety will depend upon the care used in computing the loads, in selecting the materials, and in bedding and placing the footing-courses. If *all* the loads have been allowed for at their probable maximum values, and if the material is to be reasonably uniform in quality and to be laid with care, then a comparatively small factor-of-safety is sufficient, but if all the loads have not been carefully computed, and if the job is to be done by an unknown contractor, and neither the material nor the work is to be carefully inspected, then a large margin is necessary. As a general rule, it is better to assume for each particular case a factor-of-safety in accordance with the attendant conditions than to blindly use the results deduced by the application of some arbitrarily assumed factor. The following table is given for the convenience of those who may wish to use 10 as a factor-of-safety.

SAFE OFF-SET FOR MASONRY FOOTING-COURSES, IN TERMS OF THE THICKNESS, USING A FACTOR-OF-SAFETY OF TEN.

KIND OF STONE.		R in lbs. per sq. in.	Off-set for a pressure in tons per sq. ft. on the bottom of the course.		
			0.5	1.0	2.0
Blue-stone flagging		2,700	3.8	2.7	1.9
Granite		1,800	3.1	2 2	1.5
Limestone		1,500	2.9	2.0	1.4
Sandstone		1,200	2.5	1.8	1.2
Slate		5,400	5.5	3.8	2.7
Best hard brick		1,300	2.7	1.9	1.0
Hard brick		800	1.0	.7	.5
Concrete	1 part Portland cement, 2 " sand, 3 " pebbles,	10 days old,	150	.9	.6	.4
"	1 " Ros'dale cement, 2 " sand, 3 " pebbles,	" "	80	.7	.5	.3

To illustrate the method of using the above table: assumed that it is desired to determine the off-set for a limestone footing-course, when the pressure on the bed of the foundation is one ton per square foot, using 10 as a factor-of-safety. In the table, opposite limestone in the next to the last column, we find the quantity 2.0. This shows that, under the conditions stated, the off-set may be 2.0 times the thickness of the course.

If it is desired to use any other factor-of-safety, it is only necessary to substitute for R in the preceding formula the desired fractional part of that quantity as given in the second column of the above table. For example, assume that it is necessary to use limestone in the foundation and that it is required to contract the footing-courses as rapidly as possible. Assume, also, that the pressure, P, on the base of the foundation is two tons per square foot. If the limestone is of the best and if it is laid with great care, it will be sufficient to use 4 as a factor-of-safety. Under these conditions the formula becomes

$$p = \tfrac{1}{6}\sqrt{\frac{\frac{1}{4}R}{P}} = \tfrac{1}{6}\, t\sqrt{\frac{\frac{1}{4}\times 1500}{2}} = 2.3t.$$

That is, the projection may be 2.3 times the thickness of the course.

The above method is strictly true only when the footing is solid stone. To realize these results it is necessary that no stone should project more than half its length, and also that each stone should be well bedded. The results in the table agree very well with the practice of the principal architects and engineers for hammer-dressed stones laid in good cement mortar.

The preceding results will be applicable to built footing-courses only when the pressure above the course is less than the safe strength of the mortar. The proper projection for rubble masonry lies somewhere between the values given for stone and those given for concrete. If the rubble consists of large stones, well bedded in good, strong mortar, then the values for this class of masonry will be but little less than those given for stone. If the rubble consists of small irregular stones laid with Portland or Rosendale cement mortar, then the projection should not much exceed that given for concrete. If the rubble is laid in lime mortar, the footing-course should not project more than half that allowed when cement mortar is used.

Notice that drawing in the footing-courses decreases the area under pressure and consequently increases the pressure per unit of area; hence, the successive projections should decrease from the bottom upwards.

IRA O. BAKER.

BOOKS AND PAPERS.

IT is no small undertaking to offer to a captious and exacting profession a collection of sketches of European architecture. Possibly the standards of criticism have advanced more rapidly than the art growth which the criticisms are supposed to gauge. At any rate, much more is expected now than was demanded ten or fifteen years ago, and the draughtsman who would seek approval from the profession must excel not only the work of a corresponding nature produced in this country, but must measure his strength with the work of his English cousins and his French confrères, for American art of to-day is nothing if not cosmopolitan. It is, then, with a considerable degree of satisfaction that we examine the recently-published volume of foreign sketches by Mr. J. A. Schweinfurth,[1] a work which, while not claiming to be more than a fragmentary record of a trans-Atlantic trip, is of too earnest a nature to be classed with some of the sketch-books which our *dilettanti* have offered to the public in past years. It is a production which is neither a "pot-boiler" nor a "grindstone," to use studio slang; a work which is valuable, both for its documents and its draughtsmanship; the outcome of careful observation by an architect whose experience had been the best the country could afford in the lines of preparation, who went to Europe with distinct ideas of what to study and how to find it, and who thought a great deal more than he drew. One strongly-pointed moral is brought out by the volume before us — the necessity, the inestimable advantage of a thorough training in this country before studying the architecture of Europe. The author presents us a portion only of the work of nine months; we fancy very few of our students abroad could make as good a showing for the whole of an entire year's work.

A commendable feature of the work is the absence of any encumbering literary effort. There is simply nothing but drawings. There is an index to be sure on one leaf of the cover, but as the plates are not numbered, it does not refer to anything. The drawings speak louder than words, and they speak in the way architects will enjoy. Mr. Schweinfurth tells the story fully, not contenting himself with merely indicating, but working out in detail to an extent which would cause a less conscientious draughtsman to shrink from the mere labor involved. In the drawing of the gateway of the Bishop's Palace at Sens, for instance, the mass of foliated detail, the pose and action of the semi-grotesque figures on each side, even the strong jointings of the stonework, are all fully elaborated without detracting from the harmony of the *ensemble*. The measured drawings of ceilings at Bourges and Evreux, while in the truest sense artistic, exhibit a documental accuracy which betrays the feeling of the architect, who measured them with a view to using the designs himself some day.

The author seems to have a special fondness for the old French manoirs and châteaux, and has sketched a number which are seldom seen in architectural publications. Indeed, it may be said of nearly all the subjects that they are novel, out of the beaten track, striking one at first sight as new discoveries, fresh additions to the architectural baggage of the profession; and although it is extremely doubtful if nowadays there is anything remaining in France or Italy which has not been thoroughly published a score of times, still many of these sketches are reminders of the delightful, half-forgotten by-ways of artistic travel; of the bits of quaint delicacy which lie hidden in so many of the little sleepy provincial towns, and offer such rich rewards to the patient enthusiast who fears neither the racking torture of the Italian diligence nor the digestive horrors of provincial French cookery.

The drawings are reproduced by the heliotype process and as samples of printing are very clean and sharp. They are not facsimiles, in that they are reduced considerably from the originals, a fact which is rather an advantage for the reproductions; but they show how freely Mr. Schweinfurth works with pen and pencil, to be able to make drawings so large and yet preserve such a fresh, breezy appearance, and so luminous a touch. The sheets measure 15 x 20 inches and very little of this space is wasted in wide borders. The plates are not bound but are laid loose in a portfolio of soft, pale brown canvas, with an embossed title in gold.

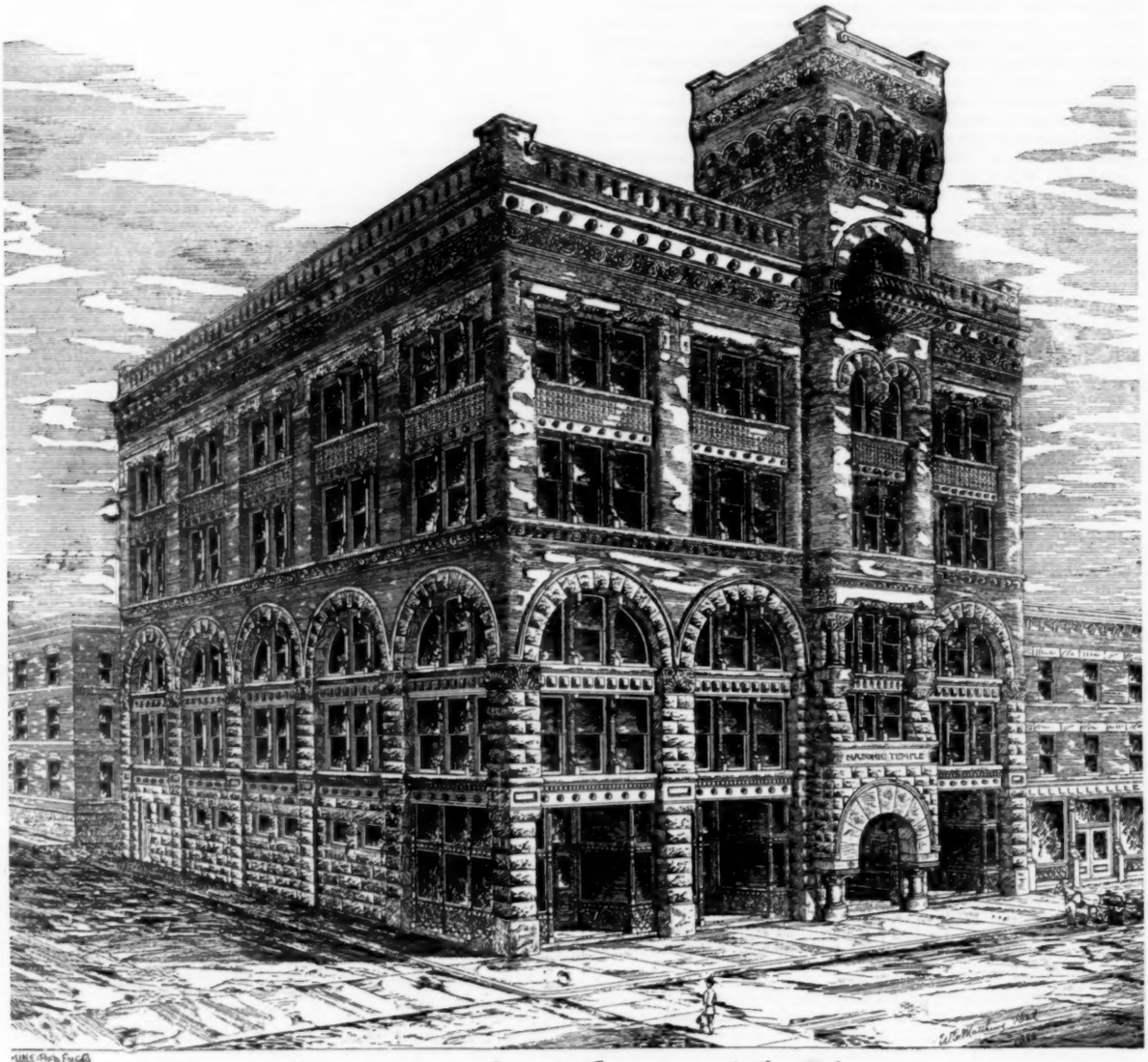
Altogether the work is a boon to the poor draughtsman and the toiling architect whose summer vacation can be spent no farther away from home than Saugus or New Jersey, but whose soul yearns for the green fields of Europe.

How came you and I and the rest of us to be architects? Did we feel the unmistakable impulses of an artistic nature? Did we stumble into the track by accident? Or were we not entered in an architect's office by parent or guardian who had been questioning all accessible friends and acquaintances as to what was the best thing to be done with us? More, we take it, have entered on their novitiate at the instance of their elders than of their own motion, and whether these have been successful or unfortunate has depended largely on how thoroughly the parent has comprehended the nature

[1] "*Sketches Abroad:*" Made during a nine months' tour through a part of Spain, Italy, France and the South Kensington Museum, A. D., 1886, by Julius A. Schweinfurth, Architect. Boston, Mass: Ticknor & Co. Price $15.00.

and intellectual capacity of his offspring and how understandingly he has informed himself as to the real nature of an architect's work. The blame for non-success should really rest as often on the father as on the son, and if the former took proper steps to measurably understand the work and the intended laborer, our offices would be cumbered with fewer incapables, who can never advance beyond a certain degree of efficiency and usefulness, but must remain through all their lives mere draughtsmen who can be trusted to do only certain kinds of work, and can never hope to reach the higher grades of that honorable guild, or hope to establish a practice of their own. In other walks of life, however, they might have become as useful and successful as any.

Many a father seeks advice at our hands, as he does at the hands of other architects, and we think that in future we will suggest that if both father and son will carefully examine the book [1] on architectural drawing written by Mr. Spiers they will both be helped in reaching a decision, for it will show very clearly what one part of an architect's work is, and will cause the elder to consider whether from what he knows of his son's character it is likely that he can in due time accomplish the results here shown, and will cause the younger to appreciate from the start that even in the matter of drawing persistent hard work lies before him.



Design for Masonic Temple
Richmond Va.
J. B. Legg Architectural Co. Architects St Louis Mo

The book was never prepared with an idea of being used in this way, and it will probably astonish the author that this use is the first that occurred to us as we turned over the pages. There have been many books written on architectural drawing, but never one like

[1] "*Architectural Drawing*," by R. Phené Spiers, F. S. A. Architect. 1888 Cassell & Co., limited: New York, London, Paris and Melbourne.

this. It is the work of a man whose own skill as a draughtsman is well known, and whose methods and ideas have become crystalized in many years which have been partly occupied in giving advisory instruction to architectural students. The *magister* is throughout subordinated to the artist. The man who speaks is one who realizes that he is addressing pupils in the main intelligent, who can seize on an idea or a hint and develop it logically. The actual method of doing this or that is not given undue prominence, as it is in many other books on drawing, but attention is constantly directed to the real object of all drawing, the production of a well-defined effect. Conscientious students of other books would at the end of their studies produce drawings essentially alike and all modelled on the manner of the author of the book; but students of this book would probably produce drawings of a similar object in a distinctly dissimilar but thoroughly individual manner, for instead of the illustrations all being prepared in the same style — that of the writer or some draughtsman selected by him — these twenty-five full-page plates show in most admirable reproductions how drawings of different classes of work were made by fifteen architects, most of whom are as well known by their work to Americans as to Englishmen. Such men as R. Norman Shaw, H. H. Stannus, Alfred Waterhouse, G. E. Street, Ernest George, J. L. Pearson, Gerald Horsely and others. These drawings were not prepared for this work, but were selected by the author as best illustrating the many different ways in which an architectural drawing can be rendered.

In the same way that illustrated books form the most valuable part of an architect's library, so these plates form the most helpful part of this book, for in the development of the artistic side of his talent the architect receives his best training through the eye, not through the ear — Ruskin's words generally excite a doubting or combative feeling, which can only be allayed by setting before the eye an illustration in support of the contention he is advancing with such affluence of verbal argument — so these illustrations do more to explain what can be done with pencil and brush than would the most careful description that Mr. Spiers could contrive.

Perhaps the most interesting and instructive chapter is the one on office-work, and, so far as we know, it is the only successful attempt to describe and explain the commonplaces of ordinary office procedure, which the student commonly has to pick up as he can in the course of his day's work, applying his own explanations to processes that he sees advancing under his own eye. The plates which illustrate this chapter show how possible it is to make a working-drawing that is thorough and workmanlike in the information it gives, and is a rebuke to those who feel that any sort of rough and incomplete drawing will serve the purpose. A thoroughly-good working-drawing is more valuable to both architect and client than the most elaborate of picture perspectives, for it has an inspiriting effect on the workman and enables him to go ahead with his part of the work with the feeling that it is all plain sailing before him, and that he has not got to waste time in trying to guess what may be the real meaning of the imperfect drawings which have been furnished him. The thorough working-drawing makes the work of the architect vastly more easy, too, in the matter of superintendence, for it enhances his authority with the workmen, who, feeling that they are dealing with a man who really understands his business, are quite willing to follow his instructions to the letter, so far as possible. In nothing more than in the character of the working-drawings made there does the good office differ from the poor one. Mr. Spiers's book is not precisely an elementary treatise and it does not give all the facts connected with the theory and practice of constructing drawings of different kinds. It is mainly suggestive and the suggestions are carried to their legitimate conclusions by the illustrations.

NOTES & CLIPPINGS

BACK-HANDED RAILWAY BUILDING IN PERSIA. — The opening of the first railway in Persia, from Teheran to Shah-Abdul-Azim, has provoked more congratulation than ridicule in this country, probably because the absurd side of the whole affair is not properly understood. The concession for the line, which eventually is to connect Teheran with the Caspian Sea, is in the hands of a Belgian syndicate, in which a Mr. Zaitchenko, Persian general-consul at Odessa, and several other Russians are concerned. The imbecility of the affair to which we are about to refer, is due obviously less to the syndicate than to the Shah, the vagaries of whose rule are responsible for the present degraded condition of the country. From the Caspian to Teheran is a distance of 200 miles, and seeing that there are no roads worthy of the name between, and the Elburz chain has to be crossed, any European would naturally have commenced at the sea end first and worked towards Teheran; particularly as the rails were sent to the Caspian from Europe via the Trans-Caucasian Railway. However, regardless of the cost, the Teheran end has been started upon first, and thus the ridiculous spectacle has been witnessed for months past of donkeys, camels, and horses tugging loads of rails and locomotives in sections from the Caspian, 200 miles to Teheran, in order that the lines might be built the wrong way. Thanks to this, although there are no engineering difficulties at all on the section just opened, the cost has exceeded 10,000*l.* a mile, or 100,000*l.* for the ten miles opened. Of this amount, even after substracting the 15,000*l.* which Russia charged as duty on the rails, etc., it is estimated that nearly half, or 45,000*l.*, has been entirely wasted in transport expenses from the Caspian to Teheran. Latterly, accounts have appeared in the press of the Shah having spontaneously thrown open his country to trade and inaugurated a new era. The same thing was said fifteen years ago when he gave a famous concession to Mr. Reuter, and on the strength of it was enabled to perform several cheap journeys to Europe and return laden with presents. Subsequently, however, his government relapsed into its previous imbecility, and if the present railway farce is any test he cannot be said to have recovered from it since. The fact of the matter is, Persia, to-day, is nothing more than a Central Asian Khanate, like Bokhara, and it is useless to expect serious improvement from its present ruler. Two adjectives are to be plentifully found in every book describing Persia for the last twenty years, "imbecile" and "idiotic," and although the construction of the Teheran Railway is a very silly affair, it is rational compared with many acts of the Persian Government recorded by travellers, while at least ten miles out of 200 have been completed. — *Engineering.*

SHAM ANTIQUITIES IN FRANCE. — Now that the time is approaching when the summer resorts of Brittany and Normandy will be patronized by seekers after fresh air, it is well (the Paris correspondent of the London *Daily Telegraph* remarks) to draw attention once more to an old subject. Among the English as well as the French visitors to such places every year there are numerous antiquarians, collectors of ceramics, and those whom the American humorists facetiously calls "Bricabrackers." Now the members, or rather imitators, of the "Black Band" are as numerous as ever in France, and they still take a diabolical and professional delight in entrapping unwary antiquarian tourists by offering sham curios, articles of vertu, pottery, coins, and medals for sale. These people cunningly distribute reputed antique bedsteads, chairs, *bahuts*, medallions, and pottery-ware in old farmhouses near watering-places. The guides, hotel-touts, villagers, and similar folk are told to sound the praises of these things in the ear of the tourist, who is flattered and delighted at the prospect of being able to pick up a bit of genuine old china, a *rococo* cabinet, a jar of "Old Gaul," and perhaps a buckler or javelin owned by one of Cæsar's legionaries. The diplomatic guide or tout is never gushing about the antiquities; but he generally insinuates in an off-handed, distant kind of a way that he knows or has heard of some old woman living leagues off who had kept such things in her family for years. The amateur antiquarian goes to the *bonne-mère*, who shows him her collection and narrates their history; how they were heirlooms from her mother, who had been in the château of a local magnate, and had hidden them at the time of the Revolution, and so on. Of course the *bonne-mère* could not, on any account, part with the things; but, as monsieur is so pressing, she has no objection to letting him have some of them at fair price. The amateur then goes on to bid for the articles, and finally departs with half-a-dozen old plates, a couple of jugs, or a rusty javelin, deeming himself lucky to have found his curios himself. Next day the bric-à-brac dealer from Paris receives notice of the successful sale, and he at once proceeds to pocket the pelf, to pay the usual percentage to all his confederates, and to replace the curiosities sold to the innocent and unsophisticated stranger by others. Thus the trade in the sham antiques goes on from year to year, and, despite exposures, there are still numerous victims annually.

THE CANALS OF MARS. — The canals of Mars were carefully observed at his last opposition, on April 11th, by M. Perrotin, the director of the observatory of Nice, under the best conditions, for the situation of the observatory is one of the finest in the world, and its telescope is large in size and excellent in definition. M. Perrotin also closely observed the so-called canals at the opposition of 1886. He found the canals, observed in 1888 in general, in the same position and presenting the same characteristic features as those of 1886. They crossed the continents in straight lines, some of them being single and others double, cutting each other at various angles. Their object seemed to be to establish communications between the seas of the two hemispheres, or between different parts of the same sea, or between the canals themselves. M. Perrotin saw something beside correspondence in his two series of observations. He bears witness to remarkable changes that have occurred between the two oppositions, not only in the canals, but on the surface of the planet. He found that the continent Lybia had entirely disappeared. Plainly visible two years ago, it no longer exists; it has been engulfed in the surrounding sea. Lake Mœris, in this vicinity, situated on one of the canals, has also vanished from sight. The extent of the region whose aspect is thus completely changed is a little greater than the surface of France. A new canal, invisible in 1886, has appeared about 25° north of the submerged continent, parallel to the equator. A third change was observed in the appearance of a kind of canal on the white spot that marks the northern pole of Mars. Its object was apparently to connect through the polar ice two seas near the pole. M. Perrotin is an astronomer who inspires confidence. His observations are no fiction of the fancy, but faithful transcripts of the wonders revealed to his practised eye on the surface of the planet Mars. Terrestrial astronomers seem at last to have reached a standpoint from which they can observe some of the changes that are taking place on the real surface of one of the planets. It is to be hoped that the opposition of 1890 will be the means of increasing our knowledge of what is going on in the domain of our ruddy neighbor. — *Providence Journal.*

INABILITY TO RECOVER A STOLEN HOUSE. — A case of unusual character has been placed in the hands of Lawyer Stevenson to apply a remedy. A landlord leased to a tenant a plot of ground, upon which was a frame house, but in the lease no mention was made of the structure. The tenant took possession of the land, and with a woman who was not his wife occupied the house. He fell considerably in arrears for rent, and a landlord's warrant was placed in the hands of a constable to levy upon his goods. Upon attempting to serve the warrant the constable discovered that the tenant had removed the house with its contents, to another man's land, and consequently the warrant could not be served. The defaulting tenant subsequently died. The question propounded to Mr. Stevenson was, What was the original landlord's remedy? After hunting up authorities Mr. Stevenson came to the

conclusion that the house, though while upon the land a part of the realty, when it was removed to another place, and thus severed from the realty, became personal property, and subject therefore to be replevined by the landlord. But he found that the replevin was barred by the Statute of Limitations. The woman, who still occupies the house, though she was never a tenant of its owner, holds the fort, without its having cost her a penny, and though a prosecution for larceny for stealing the house might have been at one time maintained, such a proceeding is barred by the criminal statute. — *Philadelphia Inquirer.*

Les Amis des Monuments Parisiens. — The atrocious meteorological conditions under which Paris has to be visited just now have not kept away foreign visitors from the Boulevards. They are arriving in considerable numbers from all parts, but particularly from Great and Greater Britain, and they are what is termed by facetious chroniclers *trimbalés*, or "carted round" from monument to monument every day. No ridicule can, however, be attached to their movements now that thousands of Parisians have themselves set to work to discover the sights and scenes of their wonderful city and its environs. The big *char-à-bancs* that you see slowly dragged along the Boulevards laden with people very often contain full-blooded Parisians as well as benighted barbarians from beyond the shimmering seas or the snow-clad hills. The time has gone by when a Parisian was ashamed to carry a "Baedeker" under his arm, and to explore the wonders of the Louvre, the Luxembourg, the Gobelins, or the Musée-Carnavalet. M. Charles Garnier and the society of "Amis des Monuments Parisiens," which he founded about two years ago, have changed all that. Before M. Garnier and the ladies and gentlemen with him took to periodical wandering all over mediæval and artistic parts of Paris there were thousands of old inhabitants who had never seen the inside of many of the metropolitan monuments and places of historic interest in their lives. They have visited the Engardine or the Tyrol for scenery, cursorily inspected the frescoes and paintings of the Pitti or the Vatican to improve their taste, but they would not be seen for worlds lounging about the corridors of the Louvre or penetrating the artistic or Arcadian recesses of Versailles. At the present time, owing to the fashion that has been set by the "Amis des Monuments," it is no uncommon thing to see a genuine Parisian wrapped in contemplation of "La Belle Jardinière" at the Louvre, or wandering enthusiastically, like a foreign *dilettante*, through the Hall of Mirrors at Versailles. As to the environs of Paris, such as Marly, Montmorency, or St. Germain, they are rendered more fashionable than ever by the patronage of the opulent people who drive thitherward in mail coaches every afternoon for dinner. — *London Telegraph.*

Electrical Sunstroke. — M. Defontaine, doctor-in-chief to the Creusot Steel-Works, states that workmen employed in operating the electric forges at Creusot are subject to a form of sunstroke which he attributes to the intense light radiated from the focus of the forge. These forges emit a light of more than 100,000 candles from a few square centimetres of surface, producing on men exposed to their glare physiological consequences previously unheard of. Frequently after two or three hours' work the men complain of pains more or less intense in the neck, the face and the forehead, simultaneously with which the color of the skin is changed to a reddish brown. Notwithstanding the use of dark glasses the retina is affected to such a degree that for some minutes after ceasing work the operatives are totally blind, nor is perfect vision restored until nearly an hour after. The secretion of tears is augmented, a constant flow being kept up for twenty-four hours, during which the patient suffers from insomnia, due to pain and the abnormal flow of tears, and possibly also to fever. During the following days the skin peals off the face and neck, which become of a deep red color, fading away about the fifth day. — *New York Star.*

The Result of Dredging at Ghirgenti. — In the harbor of Ghirgenti (the ancient Agrigentum), a dredge boat recently struck a bonanza of ancient coins and curios, including a cartload of plate and numerous Grecian statuettes, Agrigentum having been, next to Syracuse, the most flourishing colony of the sea-faring Greeks. A correspondent of a Naples journal regrets that the municipal authorities of Rome have thus far prevented a thorough dredging of the Tiber, where untold shiploads of antiquities are supposed to await a day of resurrection. The chief objection seems to be the enormous stratum of superincumbent mud, and the probable consequences of raking up the sewer deposits of twenty-six centuries. — *Dr. Oswald in Drake's Magazine.*

Economy as it is Understood at Panama. — A correspondent of the *Montreal Gazette* writes as follows: — "I have referred to the shameful way in which valuable plant is used. Now to cite a fact, to point a moral and adorn an 'o'er true tale.' Quite recently a new 4,000 kilo. *grue*, or movable crane, went off the line near the Culebra cut. They cost $2,500 each. Down the slight embankment it went. The intelligent foreman of that section, instead of making any effort to recover it, simply buried it by ordering in a train of dumping cars. The crane was buried and remains buried. Its burial simplified the whole matter. It was not his, and the company had dozens idle. Words fail to convey any idea of how machinery has been used there. An engineer told me that three-fourths of the $30,000,000 worth of machinery on the Isthmus is rusting and much of it is useless, valueless even as old metal, owing to its location. The Canal company takes credit for $30,000,000 worth of machinery on the Isthmus."

African Dwarfs. — Emin Pasha has discovered a race of dwarfs which inhabit Central Africa. They are only forty inches high, of a brown color and very agile. They eat white ants and roots, and use small poisoned arrows. — *Springfield Republican.*

A Scheme to Reclaim the Arid Regions of the West. — The Senate spent the greater part of July 30, in discussing an amendment to the Sundry Civil bill which looks to the reclamation of lands in the arid regions, for agricultural purposes, by means of a system of reservoirs and irrigating ditches. The amendment was finally passed by a vote of 29 to 18, which is a substantial victory for the friends of the amendment, since the proposition had not been favored by the Committee on Appropriations, on the ground that it would open the doors to a scheme which would involve the outlay of millions. The amendment adopted is only tentative in character. It provides for an appropriation of $250,000, to be expended under the direction of the Geological Survey, in the examination of the whole subject, in surveys and other necessary preliminary work. According to the statement of Major Powell, the director of the Geological Survey, the work of surveying the arid region alone will require $5,000,000. The work of constructing even the simplest sort of a system of reservoirs would require, according to the estimates of those who opposed this scheme, $20,000,000.

TRADE SURVEYS

One of the favorable features of the hour is the decrease in the loss due to competition. Trade and commercial combinations of all kinds are helping to bring this about through the restriction of production and the fixing of prices. Five years ago this would have been impossible, and efforts and combinations which to-day fail will in five years' time succeed. The sweeping bankruptcies of the past were losses only to individuals. The general public profited by the production of wealth. Competition has exhausted only one field, viz.: that occupied by traders and manufacturers. There are other fields for competition to till, such as competition between investors for opportunities, competition between money-lenders, competition between railroad-builders for territory to use, and competition between the seekers after opportunities of all kinds wherein labor, skill and enterprise can find employment. Competition in this direction has only begun. So far as mere cheapness is concerned, the limit has probably been reached. The next thing to watch is that expanding demand will not force prices up too high. Of this there is some probability. There is, of course, more producing capacity than is or for some time can be employed. Shrewd manufacturers who have seen the giant-like strides of American enterprise know that the nation may wake up some morning and discover stocks low and prices advancing. Two or three influences that may bring this about are these: First, the enormous volume of money that is seeking investment, and second, the fact that immigration will be restricted and labor increased in cost and value. That railroad building will boom again into old-time dimensions is probable. The entire system is gradually getting a stronger foundation to rest upon. The capital foreclosed during the first six months of this year was only twenty per cent of what it was for the first six months of last year, but the volume of capital placed under receivership was six times as much. There are several thousand miles of railroad iron in the hands of receivers or threatened with that fate. Considering the rash way railroad building has been conducted, it is a wonder that there is not ten times as much weakness. Railroad managers expect a sweeping improvement as soon as these several thousand miles can be brought under their control. There is a gradual transfer going on. Despite the unfavorable situation of railroads, a great deal of new work is projected. The depression will be corrected probably within six months. The best railroad management in Boston, New York and Chicago looks forward confidently to a restoration of harmonious relations and to a resumption of work on a large scale. General construction work is progressing very well, and a great deal more is being put in a forward condition. Financial schemes are being worked up to a practical point, so that when the safe time does come there will be nothing to do but begin construction. An authority estimates that schemes involving the expenditure of two hundred million dollars are all completed. Money that otherwise would go into railroad building will now go into manufacturing. Dividends will decline on railroads, but increase in manufacturing. The purchasing power of the people will be, as it is being, increased, and larger and more valuable interior markets will be built up. Business men feel like drawing a long breath over the end of the tariff turmoil. The politicians' holiday is over and the questions are now relegated to the people. The fear of harm coming to them will have more weight in deciding the question than the possibility of advantage. Changes of State policy or economy have always been made only as the last resort. There may be a vast amount of clatter about monopolies, but the individual supply of bread and butter will be considered first, and whatever seems to best secure these will be adopted and defended. The iron trade is getting into good shape. The mills all over the country are starting up and spring prices are ruling. The steel-rail mills have next to no business on hand and but little early business is promised. The lumber trade is in as good shape as it could be, considering the fact that market requirements have been covered to their fullest extent. The textile manufacturers are hoping, with some reason, for a further improvement. The paper-makers are generally full of orders. Boot and shoe makers have made and sold more shoes this year than last. Boiler-makers and engine-builders, car-builders and locomotive-builders have done more work this year than last. The railroad-builders have fallen away behind. The production of iron and steel is about one million tons behind. The makers of machinery in general are ahead. The agricultural interests are more prosperous because cost of traffic in many sections has been reduced and cost of most articles of consumption has declined. The mining interests have been well engaged. Coal production keeps ahead. Industrial demand, railroad demand and householders' demand all are greater than a year ago. Prices for anthracite are to be advanced September 1st. The production this year has been one week's labor greater than last year. The banks have money to lend, but find commercial paper less abundant than usual. A larger volume of business is now done on less borrowed money than ever before in our history. Borrowers are fewer in numbers. There is less mortgaged indebtedness throughout the East than in former years, more throughout the West. The money market is in excellent condition. Speculation is at a low ebb. Legitimate dealing is more general. Trusts have a hard time ahead of them and legitimate business interests have fairer prospects than ever for moderate earnings and less prospect for the enormous profits which in years past have made the fortunes of the few in a short time.

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ADVERTISERS' TRADE SUPPLEMENT.

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THE DURHAM SYSTEM OF HOUSE DRAINAGE.

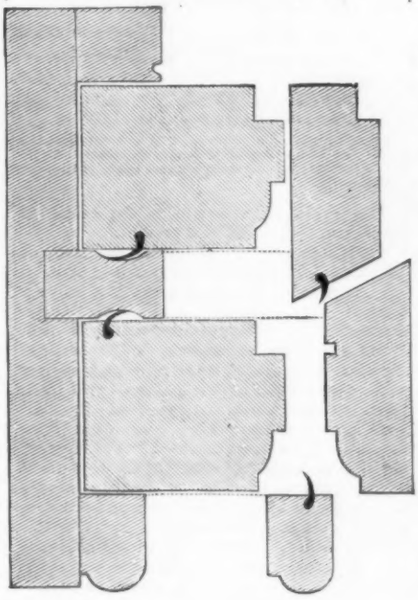
THE Durham System may be broadly described as a combination of scientific design, proper materials, and correct mechanical construction, — a common-sense application of obvious means to secure a result of vital importance.

The design of the work, the materials used, and the workmanship employed are an entire departure from the ordinary plumbing practice.

The result attained is a system of pipes which are independent of the building for support, which cannot be cracked or broken, and whose joints are permanently gas-tight beyond the shadow of a doubt.

Proper mechanical construction is the foundation of good drainage. The Durham System is a drainage apparatus constructed with wrought-iron (steam) pipe and heavy cast-iron fittings of special shapes, screwed together. This apparatus, when erected in a building, is steam-tight, elastic under pressure, and at all points absolutely invulnerable; it will last, unimpaired, as long as any building will stand — without any outlay for repairs.

Patented. — The Durham System is fully covered by patents. No patent could be obtained on the use of wrought-iron pipe, or screw joints, for drainage purpose; but the combination of wrought-iron pipe and special screwed fittings, which constitute a "new and improved" drainage apparatus, is patentable. The cost of the Durham System to the public, however, is no greater for the patents. They were secured for protection, and are not used for extortion.



MECHANICAL ADVANTAGES.

Joints. — The screw-threads on the pipes and in the fittings are cut by powerful machines, run by steam-power, to standard gauge, so that they exactly correspond. The threads are tapering, so that the further the pipe enters the fitting the tighter becomes the joint between the two. The threads are first covered with a thick paste of red-lead and oil and the pipe then screwed home by means of steam-fitters' chain tongs, by which a man can exert a powerful leverage. This work requires no skill — merely strength — and it is done in a moment. A laborer can make a tighter screw joint in one minute than a plumber with his materials could make in one hour.

Exposing Pipes. — Pipes should not be buried underground (within the building) nor hidden within the walls. It is a great satisfaction to be able at any time to examine drains and soil-pipes without the expense of tearing up. With the Durham System there is absolutely no objection to their being in plain sight everywhere; there are no joints between floor and ceiling; the pipes can be painted or bronzed, and do not betray their use or purpose in any manner. They simply look like steam-pipes, — which they actually are, — and the public have long been accustomed to the presence of steam-heating pipes. In the New York Cancer Hospital 3000 feet of our drainage pipes are in plain view, except where they pass through the floors. At the School of Mines, Columbia College, the store of Messrs. Brooks Brothers, 22d Street and Broadway, the De Vinne Press, and many other buildings, the Durham System is similarly arranged.

Smaller pipes can be used because of the absolute interior smoothness, — one inch in diameter less than is safe for plumbers' work. This effects a considerable saving. One 3-inch pipe serves two houses at Pullman.

Changes and additions of fixtures are easily and skilfully made, at very small expense, without disturbing neighboring joints. We have inserted water-closet fittings in the middle of soil-pipe stacks, one hundred feet high, at a trifling expense.

Hand-holes, closed by screw plugs, are provided at every change of direction. The owner, with the aid of a wrench, can examine the interior condition of his drains, or remove an obstruction, without incurring a plumber's bill of expenses.

Tests can be made conveniently when the Durham System is finished, by screwing plugs into all openings and turning on steam, or filling the System with water to the tops of soil-pipes. No other than a pressure test of drainage is of any value.

DURHAM HOUSE DRAINAGE CO., OF NEW ENGLAND,
207 TREMONT ST., BOSTON, MASS.

THE EVERETT WEATHER-PROOF WINDOW.

To the unitiated the accompanying cut may seem unintelligble, but it represents a device of more than ordinary merit. The left-hand portion of the cut shows a section through a window exhibiting the two sashes, upper and lower, the parting-strip, a portion of the window-frame and the stops holding the sashes in place. By observing the cut it will be noticed the parting-strip is coved out on each side and a sort of overgrown comma will be noticed, with its head in the sash and tail in the cove. This comma is the gist of the whole invention, and represents a rubber-strip which is fastened in the sash, fitting a groove made to receive it and into which it is drawn, the blade represented by the tail of the comma extending out and forming to the cove in parting-strip from either sash a complete barrier to the passage of wind or dust, obviating the necessity of other weather-strips. The portion of the cut to the right is a section of the meeting-rails of the upper and lower sash, and the small rail at the bottom represents the stop-bead at the bottom of the window, the comma in each case being a rubber-strip, thus surrounding the window completely by a rubber-strip, and forming the most perfect weather-stripping imaginable. Architects would do well to look into this as it has been thoroughly tested and is now specified in most of the best houses being put up in New York City. It is a permanent fixture and does not disfigure the windows. The device is a very simple one and reflects credit on the ingenuity of the inventor; who is also the manufacturer. We might remark that this device is as readily applied to old work as new, but for further information we refer our readers for circulars and prices to,

G. W. EVERETT,
11 EAST TENTH STREET, NEW YORK, N. Y.

THE Linoide Manufacturing Co., of Boston, has recently been established for the purpose

TABLE OF COMPARISON BETWEEN COST OF COOKING BY COAL AND GAS.

The following Table of Comparison shows the result of a careful test made by the Goodwin Gas Stove and Meter Co., of Philadelphia, between articles cooked on a Peerless Range No. 8, and a No. 7 Sun Dial Gas Stove, giving their weight before and after cooking, and their cost:

RECORD OF PEERLESS COAL RANGE NO. 8.						RECORD OF NO. 7 GAS STOVE.				
ARTICLE.	How Cooked.	WEIGHT. Before Cooking.	WEIGHT. After Cooking.	Loss per cent.	Time.	How Cooked.	WEIGHT. Before Cooking.	WEIGHT. After Cooking.	Loss per cent.	Time.
Bluefish	Baked	3 lbs.	2 lbs. 1 oz.	.32	31 m.	Baked	3 lbs.	2 lbs. 6 oz.	.20	35 m.
Rib of Beef	Roasted	9 lbs. 7 oz.	6 lbs. 8 oz	.32	1 h. 37 m.	Roasted	9 lbs. 4 oz.	7 lbs. 11 oz.	.17	1 h. 25 m.
Chicken	Roasted	3 lbs.	2 lbs. 2 oz.	.30	1 h. 6 m.	Roasted	3 lbs. 1 oz.	2 lbs. 10 oz.	.14	1 h.
Beef Steak	Broiled	1 lb. 2 oz.	13½ oz.	.25	11 m.	Broiled	1 lb. 2 oz.	15 oz.	.16⅔	8 m.
Lamb Chops	Broiled	1 lb. 1 oz.	11 oz.	.35	12 m.	Broiled	1 lb.	13½ oz.	.15	10 m.
Sweet Potatoes	Steamed	3 lbs. 5 oz.				Steamed	3 lbs. 5 oz.			
White Potatoes	Steamed	3 lbs. 8 oz.				Steamed	3 lbs. 8 oz.			
Cauliflowers	Boiled	3 lbs. 12 oz.				Stewed	4 lbs.			
Tomatoes	Stewed	4 lbs.				Boiled	3 lbs. 12 oz.			
Bread	Baked		5 lbs. 2 oz.		46 m.	Baked		5 lbs. 7 oz.		37 m.
Sago Pudding	Baked		3 lbs. 5 oz.		27 m.	Baked		3 lbs. 3 oz.		28 m.
Lemon Pie	Baked		2 lbs. 12 oz.		30 m.	Baked		2 lbs. 14 oz.		22 m.
Sauces for Fish, Beef and Cauliflower.						Sauces, etc.				

Total time from lighting of fire until everything was ready to serve, 2 hours and forty minutes. Of this time 30 minutes were required to heat the oven, leaving 2 hours and 10 minutes actual cooking time. Weight of coal, including lighting of fire, 44 pounds. At the end of the time the fire was ready for more coal. Cost of coal, 44 pounds, at $6 per ton, 11.80 cents. Kindling, 1 cent. Total, 12.80 cents.

Total time from lighting of gas until everything was ready to serve, 1 hour and 50 minutes. Consumption of gas by test meter, 38 feet. At $1.50 per thousand feet cost, 5.70 cents.

Cost of coal.....12.80 cents.
Cost of gas.....5.70 cents.
Saving over coal.....7.10 cents = 55½ per cent.

TABLE OF COMPARISON OF PERCENTAGES IN LOSS AFTER COOKING.

GAS STOVE. FISH.		RANGE.	
Cost	35 c.	Cost	35 c.
Product	28½c.	Product	24½c.
Loss	6½c.	Loss	10½c.

Saving of Gas Stove over Range, 3¾ cents.

BEEF.			
Cost	166½c.	Cost	169½c.
Product	138⅓c.	Product	117 c.
Loss	28⅙c.	Loss	52½c.

Saving of Gas Stove over Range, 24⅓ cents.

GAS STOVE. CHICKEN.		RANGE.	
Cost	61⅛c.	Cost	60 c.
Product	52½c.	Product	42½c.
Loss	8⅝c.	Loss	17½c.

Saving of Gas Stove over Range, 8¾ cents.

STEAK.			
Cost	24⅓c.	Cost	24⅓ c.
Product	20⅙c.	Product	18 9-16c.
Loss	4⅛c.	Loss	6 3-16c.

Saving of Gas Stove over Range, 2 1-16 cents.

GAS STOVE. CHOPS.		RANGE.	
Cost	20 c.	Cost	21⅛c.
Product	16⅔c.	Product	13⅜c.
Loss	3⅓c.	Loss	7⅛c.

Saving of Gas Stove over Range, 4⅜ cents.

The total saving in the cost of food cooked over Coal Range.....43 11-16 c.
Saving in cost of gas over coal (cost of coal over gas, 46 per cent.).....3 78-100c.
Total saving.....47 46-100c.

of making an article called Linoide. With this they claim the application of one coat over paint on the exterior of houses, gives it a high, glassy, durable appearance which will last for years. It is equally applicable on faded work, restoring same to its former color.

MARYLAND SERPENTINE.

Maryland Serpentine or "Green Marble" as it is familiarly known to the trade, is found in the serpentine belt as it passes through Harford County, Maryland, and belongs to the class of metamorphic rocks; it is a hydro-silicate of magnesia, containing no lime whatever, with small percentages of oxides of chrome, nickel and iron which give it its varied shades of green color, and there are occasionally, small thin veins of dolomite passing through the mass. It takes a perfect arris and an extremely fine and brilliant polish; it does not weather, but retains its polish as well as granite; there have been severe tests made of this quality by exposing small polished pieces to the weather, and after a year's time there was no perceptible change in the polished surfaces, which after cleaning with water were as bright and fresh as when first put on, nor were the rubbed or rough surfaces changed in any way.

As an ornamental stone, for wherever a green color can be used, there is no superior now known, and it is particularly adapted for wainscoting, floor and wainscot tiling, mantel facings, ashlar work, columns, pilasters, pedestals, monumental work, etc. The peculiar, non-weathering qualities render it particularly suitable for out-door work or anywhere exposed to the action of water, or the atmospheric gases which usually are so destructive to marble work.

Professor Fred. A. Genth, of the University of Pennsylvania, after a personal examination of the quarries in Maryland, reports in substance as follows, viz.:

"It is a variety of massive serpentine, somewhat resembling Williamsite, and shows sometimes a slightly slatey structure. It occurs in various shades of green, from a pale, leek green to a deep blackish green, and from a small admixture of magnetic iron more or less clouded; rarely with thin veins of dolomite passing through the mass. It is translucent to semi-transparent. The analysis of a deep green variety, gave the following results:

Silicic Acid	40.06
Alumina	1.37
Chronic Acid	0.20
Niccolous Acid	0.71
Ferrous Acid	3.43
Manganous Acid	0.09
Magnesia	39.02
Water	12.10
Magnetic Iron	3.02
	100.00

Hardness	4.00
Specific Gravity	2.668
Crushing Strength[1] per sq. in.	32,000 lbs.

NOTE.—From this analysis it is evident that the stone is a hydro-silicate of magnesia, containing no *lime* whatever, nor anything to cause decomposition or 'weathering.'

"Its green color is due to the oxides of chromium, nickel and iron present.

"It is susceptible of a very fine and brilliant polish, and furnishes, when polished, a magnificent ornamental stone, which not only on account of its durability, but also of its beauty, is superior to anything similar that is known.

"It belongs to the same class of ornamental stones as the so-called *verde-antico*, which is a white marble more or less clouded with dark green serpentine; or the "verde-d' Egetto," a mechanical mixture of predominating green serpentine with white marble: but is superior to either in many respects. In the first place it will stand weathering better than either; how little effect the atmosphere has upon it is evident from the examination of rocks on the outcrop, which, although, exposed for thousands of years, are not weathered to a greater depth than about $\frac{1}{12}$ to $\frac{1}{8}$ of an inch and are quite fresh and green below. In a polished condition it appears to me to be practically almost unalterable, as the polished surfaces do not admit of the absorption of atmospheric agencies, which cause the decomposition."

Willard H. Morse, M. D., Consulting Chemist, of Plainfield, N. J., during the year 1887, at the special request of an architect made an analysis of this serpentine, with a view of ascertaining its non-weathering qualities, etc., and his report thereon is as follows:

"Laboratory Report No. 2849, Oct. 17, 1887.

"In the matter of a specimen of 'Precious Serpentine,' said to have been obtained in the County of Harford, Maryland, furnished by a client.

"The specimen is a green stone, beautifully mottled and clouded and susceptible of a ready and brilliant polish, permanent and regular in outline. It may be described as a Hydrosilicate of magnesia, $Si\ O_2\ 2\ H_2\ O.\ 3\ (Si\ O_2\ 2\ Mg\ O) + 2\ H_2\ O$. It is granular in character, inclining to compact, with a hardness of 3.85 and having a soapy feel. Under the microscope each grain is found to represent an imperfect crystalloid, irregular in boundary and being itself constituted of a number of twinned crystaline plates. In this intimacy of structure it is evidenced that it is unlike the *ordinary serpentine* which is used for building purposes. Dissolved in acid with difficulty, it leaves as a residuum a greenish powder represented in some degree by clino-rhombic prisms. Observed under conditions correspondent with the operation of atmospheric agencies, it undergoes no alteration. Decomposition is much more difficult than is the case with marble and is not accomplished without charging water or watery vapor at a high temperature with boric or hydro-fluoric acids. In fine my laboratory estimation is that it will not respond to agencies analogous to weathering."

(Signed) WILLARD H. MORSE, M. D.

This stone has been introduced upon the market within the last year or two and is received with great favor by the architects and builders and has been used for ornamentation to a considerable extent in a great many of the large public and private buildings which are now in course of erection or recently completed: a few of the most prominent are: New Public Buildings, Philadelphia, Pa.; Equitable Insurance Co.'s New Building, New York; Bullitt Building, Philadelphia, Pa.; Ponce de Leon Hotel, St. Augustine, Fla.; State, War and Navy Depts. Building, Washington, D. C.; Fletcher Building, Wichita, Kan.; Wilmington Savings Fund Society Building, Wilmington, Del.; James Everson's Russian and Turkish Bath Building, New York.

Besides a great many others and numerous private buildings and residences.

There is also a black variety of this serpentine which is fully equal to Glens Falls black, for tiling, bordering, base-courses, etc., and much more durable.

Particular attention is called to the fact that this is *not* the Chester Co., Pa., serpentine which is used for building purposes. The entire plant, quarries and lands in Harford Co., Md., have recently changed hands and the new owners have thoroughly repaired and enlarged the plant, putting in the most improved machinery for quarrying and working the stone

[1] By Tinius Olsen & Co., Philadelphia, Pa.

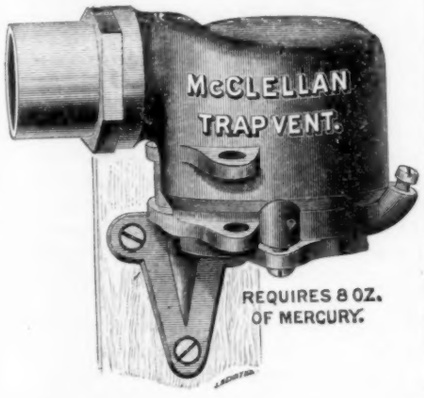
and are in a position to fill orders with promptness and despatch.

Those desiring further information, samples, prices, etc., should address,

THE SERPENTINE CO.,
9th and Market Sts., Wilmington, Delaware.

TRAP SIPHONAGE.

We have before called attention to the McClellan Vent, of which we present a cut, showing it in a somewhat different form, suited for use where a side connection is needed, rather than the older form opening from below. In referring to this device, it may not be out of place to refer to the question of back-venting, and one of the advantages this vent offers as against the usual form of running a vent-pipe to the roof. Either one of these systems proposes accomplishing the same object, namely, supplying air to the sewer side of the trap, thus saving the seal of the trap by relieving it of atmospheric pressure which otherwise would cause its siphonage. And for accomplishing this purpose both are adequate under ordinary circumstances, but there are frequently cases where back-venting by pipe-connection fails of its purpose; as where the pipe is so situated that it is more difficult to move the column of air than to siphon the trap, in which case the trap must suffer, as in fact it frequently does; but this is not the only defect; this system of



back-venting tends to create a strong and constant current of air through the vent-pipe, which tends to evaporate the water in the trap. This is especially liable to happen in small traps or those not frequently used, such as the traps under wash-trays or basins in spare rooms, where this costly and intricate system of plumbing is liable to prove anything but effective as a security against sewer-gas. In other words, this system does too much; it does not stop its work when it has prevented siphonage, but by evaporation as effectively breaks the seal; especially is this true in winter, when the air outside the dwelling is wrung to the utmost degree of dryness by the cold, and upon entering the warmer pipes of the house finds its power of absorption immediately raised and attacks the water-seal in every trap with the utmost avidity. No better proof of this can be given than the fact that in very cold weather the top of the pipe opening on the roof is frequently closed by the moisture frozen there. This defect is not found in this vent, for immediately upon the flow of waste water stopping, the vent closes and the passage of air stops, and there is no steady current creating constant evaporation, and besides, the air passing into the pipes by this vent is the warmer air of the building not the cold, dry outside air, and the tendency is rather to precipitate moisture in the pipes than to cause evaporation. We have in former reference called attention to experiments made to test this appliance, but enough has been said to show the advantage of this system of back airing over the system usually adopted, to say nothing of the large expense involved in the complicated systems in general use. If we were to prophesy regarding future plumbing systems, we should say they would tend in the future towards greater simplicity, and the present complicated systems now in use and frequently enforced by law will come to be regarded as the outgrowth of a period of mechanical lunacy.

DU BOIS MFG. CO.,
NEW YORK, N. Y.

MORTAR STAINS.

The pleasing effects attainable by the use of Mortar Stains has led to their wide-spread adoption by the architects and builders, especially in the beautiful suburban towns adjacent to large cities, where the demand for them is steadily upon the increase. The character of the coloring matter used is of course an important consideration, and as results are not always immediately manifest, too much care cannot be exercised in their selection. Competitive tests of the different brands all point to the "Pecora Mortar Stain" as the most desirable, especially in the thoroughness of its coloring qualities, permanency and absolute imperviousness to atmospheric changes. Neither heat, cold or dampness will cause it to run or bleach and in no respect does it alter the condition of the mortar, quicken the set or induce it to crumble. No more haste therefore is necessary in striking the joints than with ordinary white. Careful analysis also proves its freedom from all substances injurious to the workman and likewise demonstrates the absence of gas, oil and all impurities which tend to hinder the process of hardening. It is incapable of change and therefore cannot possibly increase the white deposit common to brick fronts, and being reduced to a smooth paste it assimilates readily with the mortar, while we have the testimony of competent experts that a given quantity of this stain will color one-third more mortar than any in use, so that, all points considered, "Pecora Mortar Stains" are by long odds the most effective and economical of all.

S. BOWEN'S SONS,
150 North 4th St., Philadelphia, Pa.

THE PRINCIPLE OF THE SANITAS WATER-CLOSET.[1]

The requisites for a water-closet are, (1) simplicity, (2) quickness and thoroughness of flushing, (3) freedom from all unscoured parts, (4) economy in construction and water consumption, (5) compactness and convenience of form, (6) amplitude of standing water in the bowl, (7) accessibility and visibility of all parts, including trap, (8) smoothness of material, (9) strength and durability of construction, (10) facility and reliability in jointing, (11) security against evaporation and siphonage, (12) ease and convenience of flushing, (13) noiselessness in operation, and (14) neatness of appearance.

The pan-closet must be discarded, because it violates every one of the above requirements.

The valve and plunger closets must be discarded, because they violate all but the sixth and twelfth requirements.

The ordinary so-called long and short hoppers are to be rejected, because they violate the second, third, fourth, sixth, tenth, eleventh, and thirteenth requirements. There is no standing water in their bowls to receive and deodorize the soil, so that they are constantly fouled. A preliminary flush is sometimes arranged to partially obviate this trouble, but this contrivance is not to be relied upon. The method of connecting the common hopper with the soil-pipe is usually defective, the seal is too shallow to withstand even a slight evaporation and siphonage, and they are exceedingly noisy in operation.

All closets which depend upon a double trap violate rules 1, 4, 7, 11, and 13. Should anything get lodged in the lower trap, it is generally impossible to get it out without taking the entire apparatus down; and when the lower trap is formed in a single piece of earthenware with the rest of the closet, an obstruction therein could not in some cases, be removed without breaking the closet open.

The side-outlet, or so-called *wash-out* type of closets, have a shallow bowl flushed by a strong stream of water, which is intended to drive the waste matters out of the bowl into a shallow trap underneath; they violate rules, 1, 2, 3, 4, 7, 11, 12, and 13.

The flushing is usually attended with spattering. The standing water in the bowl is not sufficiently deep, and the manner of flushing is noisy and ineffective, the lighter wastes frequently whirling round and round for some time before being driven out. The trap is inconvenient of access, and its seal is very shallow, and easily broken by siphonage, evaporation, or incorrect setting, and being out of sight, the evil may not be discovered until the damage is done. The pipe surface between the basin and the pipe is easily fouled and difficult to clean.

[2] In the effort to obtain a water-closet which should fulfil all of the above-mentioned requirements, the writer has made use of a principle of hydraulics new in the practice of plumbing, namely, that of supporting a water-column by atmospheric pressure acting only at its lower end. The principle is explained by the simple laboratory experiment of the inverted bottle in the basin of water (Fig. 33).

Fig. 33.—Inverted Bottle.

Fig. 34.—Water exhausted from the bowl.

If an ordinary bottle be filled with water and inverted in such a manner that its mouth shall be immersed below the surface of water in a basin below, the water in the bottle will be supported by atmospheric pressure acting on the surface of that in the basin. Let now this surface by lowered by any cause, and we shall find that it will be instantly restored from the bottle as soon as it sinks below its mouth, as shown in Fig. 34.

We have applied this principle to water-closet construction in the manner illustrated in Fig. 35. The water-closet represents our basin, and its supply-pipe our inverted bottle, which is closed at its top by the cistern-valve. If water is exhausted from the closet bowl by evaporation, siphonage, or any other cause, a

[1] Wood's "*Reference Handbook of the Medical Sciences*." Article on "Habitations: The General Principles of House Plumbing."

[2] From "*Improved Plumbing Appliances*," by J. Pickering Putnam. Published by William T. Comstock, New York, 1887.

fresh supply descends automatically from the pipe as soon as the surface sinks below its mouth. Inasmuch as in the construction of the closet, this mouth is placed above the bottom of the water-seal, it is evident that water will instantly descend from the pipe before the seal can be broken. This seal is four inches deep, and the mouth of the pipe is midway between the top and bottom of the seal, or, in other words, two inches below the normal level of the standing water in the bowl.

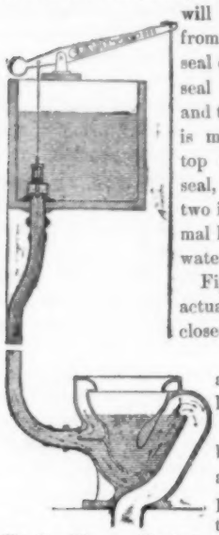


Fig. 35.—Diagram illustrating the Principle of the Sanitas Water-closet.

Fig. 36 represents the actual construction of the closet.

The action of the apparatus is as follows:

The cistern-valve being raised, the balance of atmospheric pressure is restored, the water-column in the pipe instantly begins to move, and, since it connects with the water in the closet below its level, it acts noiselessly and effects a thorough flushing.

A novelty in the general principle of construction involves corresponding novelties in many details.

The lower end of the supply-pipe is not simply opened at a single point below the water level, but is conducted to two places independent of each other, the first being intermediate between the overflow of the trap and the bottom of the seal, as is shown in Fig. 35, and the second at the bottom of the trap. The first forms the mouth proper of the "inverted bottle" and supplies water to the flushing-rim, and the second furnishes a jet which lifts part of the water out of the trap and bowl by its propelling power. Since both jets enter below the level of a large body of standing water in the bowl, their noise is deadened, and, as the supply-pipe always stands full, they act instantly, and the flushing of the closet is very rapid. The lower jet causes the water and waste matters in the closet to sink into the neck of the bowl. Meanwhile, the upper jet fills the passages and annular chamber leading to and surrounding the flushing-rim, overflows, and descending into the neck of the bowl, falls upon and drives out the waste matters collected in the neck quietly and without waste of water.

The cistern-valve being again closed, movement in the supply-pipe immediately ceases, and the water in the flushing-rim and passages leading thereto, falls back into the closet and restores the normal level of the standing water in the bowl and trap.

The form of the closet bowl is shown in plan in Fig. 37. The standing water has the shape best calculated to receive and deodorize the waste matters falling into it. It is deepest at the back of the closet, and very deep at the point where the wastes strike. Its surface is long and comparatively narrow, and is not round or elliptical, as has heretofore been customary. The reason for this is simple, and will easily be understood upon reflection. We know that the user of a closet will sometimes sit forward, and sometimes back on the seat, according to circumstances, but it rarely, if ever, happens that he will sit laterally out of centre, inasmuch as this would be extremely awkward and uncomfortable. Hence the water surface should have considerable longitudinal extension, while much less lateral extension is required; and we have found that the narrower the water surface within certain limits, the more easily, quickly, and economically in respect to water consumption will the waste matters be expelled. By examining Fig. 36 it will be observed that the under surface of the bowl is horizontal from front to rear, except at the outlet, and that this surface is immersed under an inch or so of water. It will also be observed that the water-slots in the flushing-rim are largest in the front and rear, and gradually diminish as they extend round to the sides. The result of this conformation is that the upper flushing water jumps on top of the waste matters and acts to the best possible advantage in driving them quickly out, and the closet can be easily flushed in three seconds by less than a gallon and a half of water.

A stream of water may be rendered noiseless, however rapid and powerful its movement, by properly directing it into a body of water larger than itself, provided the point of entrance be below the surface. It is not sufficient to do this in the manner usual in the old form of English and French siphon-jet closets, because the jet in these at once throws the standing water out of its way, and then makes an uproar even more appalling than the ordinary flushing stream. In these "siphon-jet" closets, the water used for cleansing the upper part of the bowl, when used in combination with the jet in the trap, is not only insufficient to keep the lower jet covered, but makes a most disagreeable clamor of itself, after the usual manner with modern closets.

The upper flushing stream should furnish a body of water nicely calculated to keep the lower stream just covered, and should itself be noiseless. The former result is easily attained by simply adjusting the size of the upper and lower flushing openings with reference to each other; the latter by constructing a special chamber into which the upper flushing stream may be projected before it enters the bowl.

Fig. 36.—Actual Section of the Sanitas Water-closet.

The upper part of this chamber forms an annular ring and surrounds the flushing-rim. Being above the level of the standing water in the bowl, it receives only clean water. Being constructed in such a manner as to drain itself back into the closet bowl after each flushing action, it stands, like the flushing-rim proper, empty at all times excepting during the moment of flushing. The upper jet discharges into the standing water in the lower part of this chamber, and its sound is instantly and entirely deadened. The water rises in the annular chamber and overflows through the flushing-rim to descend quietly into the bowl, lubricate its sides, and assist the lower stream in ejecting the wastes and flushing the closet and drain-pipes.

In order to make a perfectly and permanently tight soil-pipe connection, metal plates, or shoes, are used. These shoes are cast to exactly fit the porcelain base. The shoe has a four and one-half inch hole in it, corresponding with the outlet hole in the water-closet. The lead pipe which is to connect the closet with the iron soil-pipe is to be first flanged over the four and one-half inch hole in the shoe at the floor, and the closet is then set in place on the shoe and screwed down by means of four brass machine-screws which are furnished with each closet. The holes in the earthenware base correspond with the threaded holes tapped in the shoe. A mixture of red lead and putty is used between the earthenware base and the metallic shoe, and when this hardens the whole becomes, as it were one piece, and the closet is thus independent of shrinkage or settling of the floors. All movement takes place in the flexible lead-pipe below, which should always be used between a closet and the rigid iron soil-pipe. The joint thus becomes a permanently sewer-gas tight metallic joint which cannot be injured by jarring, settlement, or shrinkage in the building.

It will be observed, by referring to the perspective drawing, that the closet is provided with a cistern overflow connection at the flushing rim. The same pipe may serve also as a ventilating pipe. By connecting this with a proper ventilating flue above the cistern, in the manner shown in the drawing, Fig. 38 (on p. 44), the seat and bowl of the closet may be ventilated. Such ventilation is serviceable at the moment of usage of the closet, but it is not needed for the bowl and trap themselves, which are kept odorless by their construction and arrangements for flushing. It is well, however, always to ventilate toilet-rooms, for the purpose of removing the vapor and gases generated during their use by the occupant and by the gas burning, and as good a place as any to locate the ventilating outlet is under the seat of the water-closet in the manner described.

Fig. 37.—Plan of Closet.

Let us now examine our table of desiderata, and see in how far this closet conforms to the various items.

1. Simplicity. We find here the simplest form possible with closets. The trap and the bowl are one and the same thing. Each forms half of the other. The flushing is accomplished by the pressure of the water only, and without machinery of any kind in the closet. We have, in fact, the simplicity of the short hopper, which is the simplest form of water-closet known.

2. Quickness and thoroughness of flushing. The maximum of rapidity of flushing is attained by having the supply-pipe always full of water, so that the action at the lower end takes place simultaneously with the lifting of the valve, and all delay and loss of power occasioned by the water falling from the cistern through the pipe and against the resistance of the enclosed air is avoided. The combined action of the two lower jets of water is, moreover, as already described, such as to accomplish the removal of the waste matters with the utmost speed, in virtue of their coöperation.

The *thoroughness* of the flushing or cleansing action, with a given quantity of water, is evidently in direct proportion to the rapidity and direction of the action, it being assumed that the surfaces to be flushed are properly constructed to receive it, as is the case with the closet under consideration. The form and volume of the standing water in the bowl is such as to protect the sides from being fouled

by adhesive matters. The solid and heavy wastes, which are the adhesive ones, cannot fall against these sides. If liquid or semi-liquid matters are projected against them they will not stick. Therefore these sides require not so much great *force* as a *uniform distribution* of the flushing water. The parts which require scouring force are those below and beyond, including the trap and the main soil and drain pipes, and it is these parts which in this closet receive it. The scouring action on the pipes is here equal to that of the plunger-closet, while it is free from the siphoning action on fixtures below of the latter; for air freely follows the discharge and prevents the formation of a vacuum.

3. Freedom from all unscoured parts. The closet contains no cesspool in its construction, and has the minimum extent of surface, interior and exterior, possible in a water-closet.

4. Economy in construction and water consumption. Being constructed of a single piece of earthenware of compact and simple form, this desideratum is met. The consumption of water is reduced to a minimum, in the manner already explained. No loss of power is sustained in the supply-pipe, and each drop in the closet acts in the most effective manner, in concert with the rest, to produce a rapid and thorough flush.

5. Compactness and convenience of form. The closet occupies the minimum of space, as may be seen from the perspective drawing. The outlet is under the centre, which facilitates its setting.

6. Amplitude of standing water in the bowl. The standing water has the proper form and depth, and its surface is calculated to stand at the most desirable distance below the seat of the closet. It will be seen, upon reflection and experiment, and in testing different forms of water-closets, that the nearer the seat the surface of the standing water can be brought, the less liability there will be for spattering when the soil falls into it. In fact, if the surface could be brought so near that the soil would actually touch it before falling, there would be no spattering at all. But, of course, it should not stand so near as to come in contact with the person. The distance established as the best, all things considered, is five inches below the top of the flushing rim, and this distance has been adopted in the case of the Sanitas closet.

7. Accessibility and visibility of all parts, including the trap. A study of the drawings will show that this desideratum has been attained. The closet and trap, as well as its supply-pipe and cistern, may easily be emptied by a sponge or ladle when the house is closed during the winter.

8. Smoothness of material. The closet being constructed of glazed earthenware in a single piece, and everywhere with easy bends, this requirement is fully answered.

9. Strength and durability of construction. The compact and simple form of the closet, the central position of the base under the bowl giving it equal and firm support, and the soundness and reliability of its soil-pipe connection, give it the greatest strength and durability possible with water-closets.

10. Facility and reliability of jointing. There is but a single, simple, and strong brass coupling connection to be made with the supply, and a single connection with the waste-pipe. The small coupling at the flushing-rim for a seat-vent and cistern over-flow may be used or closed up, as desired.

11. Security against evaporation and siphonage. The new principle of supply already described, together with the unusual depth of the water-seal, render this closet practically secure against loss of seal through evaporation and siphonage.

12. Ease and convenience of flushing. It is only necessary to pull the valve-chain and immediately release it again to obtain a sufficient, and no more than sufficient, flush. The trap and bowl refill themselves automatically after the flush. The valve may also be operated by a simple seat or door attachment, if desired.

13. Noiselessness in operation. This very important desideratum has been much neglected in modern water-closet construction. It has hitherto been assumed that it would be impossible to combine noiseless action with a powerful and rapid water scour. Nevertheless, this has been accomplished in our Sanitas closet in the manner already described; and the closet may be used in becoming secrecy, as is agreeable to civilized people, and without the usual "flourish of trumpets," which so ridiculously proclaims the fact to the household whenever any one has sought a moment of special privacy.

14. Neatness of appearance. Now that the wise custom of setting all the plumbing fixtures open is becoming every day more general, it is important that every fixture should be so designed as to present an agreeable and appropriate appearance. By this we not only save the expense of panelled woodwork, but secure better workmanship and healthier houses.

SANITAS MANUFACTURING CO.,
207 TREMONT STREET, BOSTON, MASS.

MORTAR COLORS.

IT is now an established fact that our mortar colors of which we are the sole importers in the United States, are the most superior, most satisfactory and the most economical to be had for the following reasons:

1. That if properly and thoroughly mixed they will enhance the binding power of the mortar and will not fade or run.

2. Are the most satisfactory, because they are always homogeneous in composition.

3. Are the most economical because they are fully 40 per cent stronger than any now in the market, and are sold in a dry state only, thus giving you net weight and pure color.

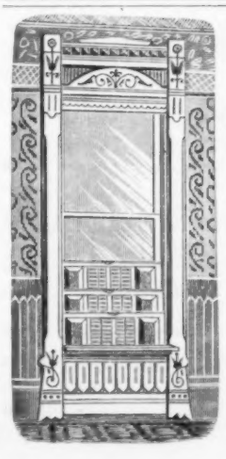
Our Front Oil, for oiling fronts and making fronts uniform and water and weather proof, is by far cheaper than linseed oil and answers the purpose much better, as it does not resinize so easily.

We are confident that any builder who has used our mortar colors and front oils, and used them properly, will continue to do so, in preference to any other.

Respectfully yours,
TOCH BROTHERS,
35 BOWERY, NEW YORK, N. Y.

NOTES.

THE sales of Babcock & Wilcox boilers for May and June, 1888, are as follows: Edison Electric Illuminating Co., Paterson, N. J., 250 horse-power; Planters' Sugar Refinery Co., New Orleans, La., 240 horse-power; Girard Estate, Philadelphia, Pa., fourth order, 51 horse-power; C. Bruin & Co., Milan, Italy, 10 horse-power; David Colville & Sons, Motherwell, near Glasgow, Scotland, third order, 700 horse-power; Mineral Railroad & Mining Co., Wilkes-Barre, Pa., second order, 240 horse-power; McWhirter, Ferguson & Co., Glasgow, Scotland, second order, 51 horse-power; The Platt-Lane M'f'g Co., Ltd., Hindley, England, 124 horse-power; Bureau Provisions and Clothing, Washington, D. C., second order, 1040 horse-power; Imperial Continental Gas Ass'n, for Vienna Opera-House, Vienna, Austria, second order, 248 horse-power; Mrs. R. S. Welham, Homestead Plantation, St. James Parish, La., second order, 156 horse-power; L. Stern & Co., Ltd., London, England, fourth order, 130 horse-power; Edison Phonograph Works, Orange, N. J., 146 horse-power; American Glucose Co., Buffalo, N. Y., second order for Peoria, 960 horse-power; Phœnix Horse Shoe Co., Poughkeepsie, N. Y., 146 horse-power; Eagle Paper Co., Franklin Ohio, second order, 122 horse-power; W. M. Foster, Melbourne, Australia, second order, 45 horse-power; Montreil & Co., Petit-Quevilly, France, 82 horse-power; Florida Sugar M'f'g. Co., St. Cloud, Florida, second order, 240 horse-power; Oneco M'f'g. Co., New London, Conn., 208 horse-power; Ferdinand Bracq, Ghent, Belgium, 105 horse-power; The House-to-House Elec. Lt. Supply Co., L'd, Kensington, Eng., 468 horse-power; Irene Brun & Co., St. Chamond, France, 92 horse-power; Westinghouse Air Brake Co., Allegheny, Pa., second order, 92 horse-power; Edison Electric Ill'g Co., New Orleans, La., 312 horse-power; Solvay Process Co., Syracuse, N. Y., sixth order, 416 horse-power; James Leslis Wonklyn, Doré Hotel, Bournemouth, England, 65 horse-power; American Glucose Co., Buffalo, N. Y., tenth order, 208 horse-power; Dodge M'f'g. Co., Mishawaka, Ind., 272 horse-power; Department of the Interior, Washington, D. C., 122 horse-power; Marshall Bros., & Co., Philadelphia, Pa., 272 horse-power; Societa Italiana Generale di Elettricita, Sistema Edison, Milan, Italy, sixth order, 479 horse-power; Societa Italiana Generale di Elettricita, Sistema Edison, seventh order for Royal Italian Naval Arsenal, Spezia, Italy, 186 horse-power; Lehigh Coal & Navigation Co., Philadelphia, Pa., fourth order, 832 horse-power; Westmoreland Paper Co., West Newton, Pa., second order, 480 horse-power.



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Perhaps the most exhaustive tests that could be applied to Portland Cement were made on "Black Cross" which was selected by the Library Commission after reports made by General Meigs and Lieut.-Col. Peter C. Hains recommending it for the concrete foundations of the Congressional Library Building, Washington, D. C., as the most suitable for the work after other brands had been condemned.

It is remarkable for its absolute uniformity and capacity to carry a larger aggregate when compared with other well known brands of cement, which makes it the most economical to use.

We learn that it is more extensively employed than other kinds in the construction of the New Croton Aqueduct, and some is purchased by the New York Dock Department for construction of bulkheads on the river front.

To those interested in this subject a pamphlet under the caption "Some Information on Portland Cement" will be sent on application to Howard Fleming, 23 Liberty Street, New York.

The Chalmers Spence Company of New York, whose Asbestos goods, more particularly their removable pipe and boiler coverings, are well known throughout the United States, removed their Philadelphia office, July 16th from 32-34 South 2d Street to 24 Strawberry Street, where their representative will be pleased to show their Asbestos specialties and explain their merits to all interested parties.

The Whittier Machine Company are putting into the Sherman House, Boston, a new hydraulic passenger elevator operated by their pressure tank system. They are also putting into the building No. 19 Kilby Street, occupied by Mr. J. C. Paige, a new hydraulic passenger elevator operated by their pressure tank system.

BUILDING INTELLIGENCE.

Reported for the American Architect and Building News.

ALTERATIONS.

Philadelphia, Pa.—*Sixtieth St.*, s e cor. Market St., shed addition to feed-store; owner, Jacob Zell, Fernwood, Del. Co.

Frankford Ave., w s, bet. Green and Rann Sts., front to stone building; owner, Walter Scott, 4244 Frankford Ave.

Fourth St., e s, bet. Oxford St. and Columbia Ave., one-st'y front building and interior alterations; owner, William Tuklenburg, 1614 Cadwalader St.

Twenty-second St., s e cor. Trinity Pl., French roof on dwell.; owners, Stacy, Reeves & Sons, 1611 Filbert St.

Leiper St., No. 4408, two-st'y addition; owner, James Blakely.

South Tenth St., No. 758, addition to back building and bay window; owner, Chas. T. Brown, 755 Florida St.

Ingersoll St., No. 2403, brick front; owner, Joseph Doyle, 3918 Pine St.

Newmarket St., n w cor. Wood St., three-st'y addition; owner, C. Joos, 504 Vine St.

South Thirteenth St., No. 103, rear, two-st'y addition; owner, Thomas A. Lynch, 1619 North Fifteenth St.

Cresson St., e s, bet. Grape and Cotton Sts., one-st'y addition; owner, John Steinler, Manayunk Ave., near Shur's La.

HOUSES.

New York, N. Y.—*Union Ave.*, w s, 75′ e Ritter Pl., two-st'y brick and frame dwell., tin roof; cost, $3,800; owner, Mary A. Connolly, 2712 Third Ave.; architects, Arctander & Meyer, 528 Willis Ave.

One Hundred and Fifty-ninth St., n s, 175′ e Boulevard, 10 three-st'y brick dwells., tin roofs; cost, $55,000; owner, Mary E. Carlin, One Hundred and Forty-third St. and Eighth Ave.; builder, John Carlin, One Hundred and Forty-third St. and Eighth Ave.

Forty-seventh St., n s, 175′ e Lexington Ave., 6 three-st'y brick dwells., tin roofs; cost, $84,000; owner, Angelo Mondofo, 116 East Fifty-ninth St.; architects, Schneider & Herter, 48 Bible House.

Eighty-fourth St., n s, 450′ w Eleventh Ave., three-st'y brick dwell., tin roof; cost, $18,000; owner, Mathias Murray, 152 West Eighty-third St.; architect, John M. Dunn, 1193 Broadway.

Sedgwick Ave., e s, 150′ n One Hundred and Eighty-fourth St., two-st'y brick and frame dwell., peak and shingle roof; cost, $8,500; owner, John W. Hutchinson, 353 West One Hundred and Twenty-third St.; builders, Coöperative Building Plan Association, 63 Broadway.

West End Ave., s w cor. Eighty-sixth St., 10 four-st'y brick dwells., mansard, tin and slate roofs; cost, $180,000; owner, Jacob Lawson, Brooklyn, N. Y.; architect, Jas. H. Taft, 146 Broadway.

West End Ave., s e cor. Eighty-fifth St., 5 four-st'y brick dwells., mansard, tin and slate roofs; cost, $100,000; owner, James B. Gunn, 1710 Tenth Ave.; architect, Jas. H. Taft, 146 Broadway.

Palisade Ave., s e, abt. 300′ s Spaulding La., three-st'y frame and brick dwell.; cost, $20,000; owner, Percy Pyne, 25 East Twenty-second St.; architects, Renwick, Aspinwall & Russell, 71 Broadway.

Washington Ave., e s, 68′ n One Hundred and Sixty-eighth St., two-st'y brick and frame dwell., tin roof; cost, $5,500; owner, John Mauser, 1315 Washington Ave.; architect, Adolph Pfeiffer, 2773 Third Ave.

Percy R. Pine, brick and stone dwell.; architects, Renwick, Aspinwall & Russell.

Philadelphia, Pa.—*Federal St.*, s s, w Twenty-fourth St., 15 two-st'y dwells.; contractor, George S. Spelt, 1621 Hicks St.

Amber St., w s, bet. Huntingdon St. and Lehigh Ave., three-st'y dwell.; contractor, D. C. Schuler, 2327 North Sixth St.

Ninth St., w s, bet. Berks St. and Montgomery Ave., 3 two-st'y dwells.; contractor, John K. Brinkworth, 2152 East Dauphin St.

North Third St., No. 908, three-st'y dwell.; builders, C. F. Wells & Sons, 4080 Spring Garden St.

Fairmount Ave., s s, bet. Forty-sixth and Markoe Sts., 14 three-st'y dwells.; owner, James J. Loughery, n e cor. Forty-first and Haverford Ave.

Mill Grove Ave., n w s, bet. Germantown Ave. and Thirtieth St., 2 two-st'y dwells.; builder, Ashton S. Tourison, 5541 Germantown Ave.

Howard St., e s, bet. Diamond St. and Susquehanna Ave., three-st'y dwell.; contractor, Chas. E. Myers, 2426 North Sixth St.

Hope St., w s, bet. Diamond St. and Susquehanna Ave., 2 two-st'y dwells.; contractor, same as last.

Sixty-third-and-a-half St., e s, bet. Arch and Race Sts., 2 two-st'y dwells.; builder, William Douglas, 330 North Sixty-third St.

Sixth St., w s, bet. Huntingdon St. and Lehigh Ave., three-st'y dwell.; contractor, Henry G. Schultz, 2633 Germantown Ave.

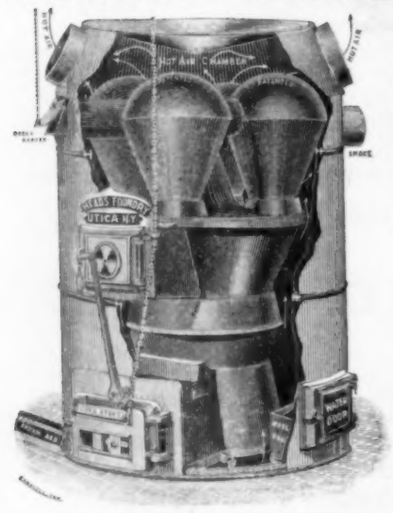
Dounton St., n s, bet. Juniata and Howard Sts., 5 two-st'y dwells.; owner, James Mole, 1707 Dounton St.

Mather St., n s, bet. Sixteenth and Seventeenth Sts., two-st'y dwell.; owner, same as last.

Twenty-third St., e s, bet. Ellsworth and Federal Sts., 11 three-st'y dwells.; contractor, Henry R. Coulomb, 731 South Tenth St.

Broad St., e s, bet. Tasker and Morris Sts., three-st'y dwell.; owner, E. R. Cassady, 842 Wharton St.

Twenty-sixth St., bet. Fletcher and Dauphin Sts., 2 three-st'y dwells.; contractor, E. P. Hall, 2317 North Thirteenth St.



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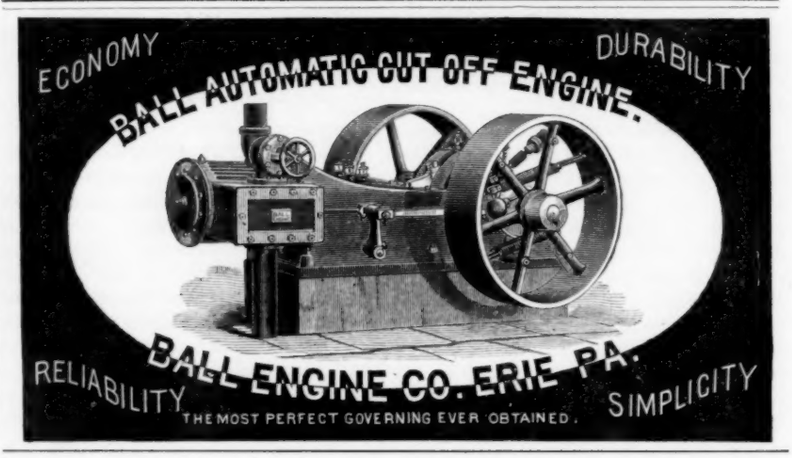

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Thirty-third St., e s, bet. Spring Garden and Rockland Sts., 6 three-st'y dwells., 2 with stores; contractor, Hartman Grau, 652 Preston St.

Bet. Cayuga St. and Germantown Ave., 10 four-st'y dwells.; contractor, James Mole, 1707 Dounton St.

Emily St., bet. Fourth and Fifth Sts., 18 two-st'y dwells.; contractor, William J. Ross, 2025 Oakford St.

Mercy St., n s, bet. Fourth and Fifth Sts., 11 two-st'y dwells.; contractor, Michael J. Cassidy, 1102 Camilla St.

Ellsworth St., No. 919, seven-roomed dwell.; owner, William MacRae Bryant, 915 Spruce St.

Third St., e s, bet. Dauphin and York Sts., 11 three-st'y dwells.; contractor, John S. Serrill, 1413 North Broad St.

Dauphin St., n s, e Third St., 3 three-st'y dwells.; contractor, same as last.

J. J. Deery, architect, 328 Walnut St., has prepared plans for a three-st'y brick dwell. to be built cor. Chestnut and Thirty-eighth Sts., for Pedro Galan; cost, about $15,000; no contracts let.

P. A. Welsh, architect, 429 Walnut St., has prepared plans for a stone dwell., with all modern conveniences, at Chestnut Hill, for H. F. McCann; no contracts let.

J. F. Stuckert, architect, 524 Walnut St., has prepared plans for 100 dwells., to be built on Twenty-seventh St. and Lehigh Ave., for Thomas Waters; cost, each, about $3,000.

Willis G. Hale, architect, 919 Chestnut St., has prepared plans for three-st'y stone dwell., with all conveniences, to be built cor. Walnut Lane and Wayne Ave., for Col. William M. Gregg; cost, about $30,000.

James H. Windrim, architect, 132 South Third St., has prepared plans for 2 four-st'y brick and brownstone dwells., to be built cor. Green and Twenty-second St., for William H. Temble; cost, about $50,000; to be built by day work.

James H. Windrim, architect, 132 South Third St., has prepared plans for a brick and stone dwell., with tile roof and and modern conveniences, to be built at Chestnut Hill, for Jacob S. Disston; cost, about $30,000; contract to be let shortly.

Wilson Eyre, Jr., and W. E. Jackson, architects, are working on a dwell. to be built on Graves Lane, Chestnut Hill; cost, about $12,000; no contracts let.

Wilson Eyre, Jr., and W. E. Jackson, architects, have removed to their new offices, 927 Chestnut St.

Somerset St., s s, bet. Park Ave. and Thirteenth St., 14 two-st'y brick dwells.; contractor, Thos. H. Flood, 2747 Frankford Ave.

Fifty-second St., w s, bet. Master and Thompson Sts., three-st'y brick dwell.; builder, William H. Jones, cor. Fifty-third St. and Wyalusing Ave.

Morris St., n s, bet. Broad and Rosewood Sts., 3 three-st'y brick dwells.; owner, George Lodge, 1200 South Third St.

Jarrett St., s s, w Twenty-second St., 10 two-st'y brick dwells.; owners, R. & A. Wilson, 1711 South Twentieth St.

Media St., s s, e Sixty-first St., 4 two-st'y brick dwells.; builder, Lewis W. Goodman, 3602 Sansom St.

Providence, R. I.—*Chester Ave.*, frame dwell.; cost, $2,800; owner, W. J. Meany; builder, J. H. Canning.

Langley St., n, frame dwell.; cost, $2,400; owner, P. Connely; builder, J. H. Canning.

Dudley St., cor. Tanner St., 2 frame dwells.; cost, $4,000; owner, E. G. Burrows, Jr.; builder, B. A. Mason.

Coville St., e, frame dwell.; cost, $2,500; owner, Katharine Gray; builders, Watts Bros.

Eagle St., w, 2 frame dwells.; owner, J. McKenna.

Fairmount St., dwell.; cost, $1,400; owner, Catharine Paisley; builders, Sweet & Winsor.

Atwell's Ave., frame dwell.; cost, $1,500; owner, H. Manning.

Brook St., e, frame dwell.; owner, S. M. Nicholson; architects, Gould & Angell; builder, H. Goff.

Messer St., frame dwell.; cost, $2,600; owners, Harris & Perry.

Wickendon St., frame dwell.; cost, $3,000; owner, E. Walsh; builder, T. W. Barry.

Anthony St., frame dwell.; cost, $2,500; owner, T. Grimes; architect, E. I. Nickerson; builder, J. Weeden.

Washington, D. C.—*Connecticut Ave.*, two-and-a-half-st'y frame dwell.; cost, about $7,000; owner, G. G. Presbrey; contracts not let.

West Philadelphia, Pa.—F. K. & W. R. Price, 731 Walnut St., have prepared plans for a dwell. to be built at cor. of Thirty-third and Arch Sts., for Mrs. J. Graham; cost, about $9,000; contracts not let.

STABLES.

New York, N. Y.—*Railroad Ave.*, e s, 91′ 3″ n One Hundred and Thirty-eighth St., two-st'y brick stable, tin roof; cost, $15,000; owner, American Express Co., 65 Broadway; architect, Edward H. Kendall, 1 Broadway.

West Thirty-sixth St., No. 556, three-st'y brick stable, tin roof; cost, $12,000; owners, Rohe & Bro., 266 West Thirty-third St.; architects, Thom & Wilson, 1267 Broadway.

Philadelphia, Pa.—*Buist Ave.*, bet. Sixty-first and Sixty-second Sts., frame stable; contractor, Joseph Lewis, 6214 Buist Ave.

Romulo Vasquez, Holmesburg, Philadelphia, is making drawings of stable for Titus Brothers of that place.

Broad St., e s, bet. Tasker and Morris Sts., two-st'y stable; contractor, E. R. Cassady, 842 Wharton St.

Twenty-sixth St., e s, bet. Fletcher and Dauphin Sts., stable; contractor, L. P. Hall, 2317 North Thirteenth St.

STORES.

Brooklyn, N. Y.—*Stuyvesant Ave.*, s e cor. Halsey St., three-st'y brownstone store and dwell., tin roof; cost, $8,000; owners and builders, Lambert & Mason; architect, I. D. Reynolds.

Fourth Ave., w s, 65′ s Twenty-sixth St., 4 three-st'y brick stores and tenements, tin roofs; cost, each, $5,400; owner, M. Dalton, Twenty-sixth St., bet. Third and Fourth Aves.

Bedford Ave., n e cor. Guernsey St., two-st'y frame store and loft, gravel roof; cost, $3,000; owners and builders, Randall & Miller, 16 Bedford Ave.

Reid Ave., w s, 25′ s Pulaski St., 2 four-st'y brick stores and flats, tin roofs; total cost, $18,000; owner, E. A. Post, 745 Van Buren St.; architect, H. Vollweiler; contractor, S. W. Post.

Prospect St., n e cor. Hamburg Ave., three-st'y frame (brick-filled) store and dwell., tin roof; cost, $3,500; owner and builder, P. Thawer, Flushing and Hamburg Aves.; architect, Th. Engelhardt.

Detroit, Mich.—Peter Dupont & Co., frame store 434 Croghan St.; cost, $7,500.

A. E. French, 3 two-st'y stores, Nos. 101-105 Michigan Ave.; cost, $9,200.

Peter Dedericks, Jr., two-st'y brick store, 386 St. Aubin Ave.; cost, $5,000.

John P. Schmitt, two-st'y brick store, Gratiot Ave.; cost, $4,000.

Jos. Wolf, two-st'y frame store, Michigan Ave. and Twenty-sixth St.; cost, $2,000.

New York, N. Y.—*East Forty-second St., Nos.* 148-150, five-st'y brick store, gravel roof; cost, $16,000; owner, James Renwick, 71 Broadway; architects, Renwick, Aspinwall & Russell, 71 Broadway.

Third Ave., No. 2590, one-st'y frame store; cost, $3,000; owner, Mary C. Steele, 2592 Third Ave.; architects, Arctander & Meyer, 528 Willis Ave.

One Hundred and Twenty-fourth St., n s, 100′ w Third Ave., two-st'y brick store, gravel roof; cost, $20,000; owner, Edward Rothschild, 230 East One Hundred and Twenty-fourth St.; architects, Buchman & Deisler, 8 West Twenty-ninth St.

Philadelphia, Pa.—Angus S. Wade, architect, 20 South Broad St., is working on plans for a store on Lancaster Ave., near Preston St., to be of pressed-brick, with English redstone trimmings; cost, about $20,000.

Chestnut St., n s, bet. Fifth and Sixth Sts., four-st'y fireproof store and office-building; contractors, Samuel Hart & Sons, 1184 Wallace St.

Cumberland St., n e and n w cors. Sartain St., 3 stores, and 1 store, s e cor. Huntingdon and Sartain Sts.; owner, John Loughran, 2544 North Eighth St.

Twenty-third St., e s, bet. Ellsworth and Federal Sts., 2 stores; contractor, Henry R. Coulomb, 731 South Tenth St.

Frankford Ave., No. 3107, three-st'y store; owner, Frank N. Forsyth, 2125 Jefferson St.

Third St., e s, bet. Dauphin and York Sts., store; owner, John S. Serrill, 1413 North Broad St.

Thirty-third St., cor. Spring Garden St., and *Thirty-third St.*, cor. Rockland St., 2 stores; owner, Hartman Grau, 655 Preston St.

MISCELLANEOUS.

Boston, Mass.—*Warren Ave.*, near Front St., Ward 5, two-st'y freight-building, flat roof, 30′ x 350′; owner, Fitchburg R. R. Co.; builder, E. K. Turner.

Condor St., cor. Brooks St., Ward 1, one-st'y brick pumping-station, 47′ x 55′; owner, City of Boston; builders, Donahue Bros.

Cincinnati, O.—Schmidt & Bro., two-st'y ice-works, McMicken St.; cost, $4,000; architect, John Ball.

Philadelphia, Pa.—*Christian St., No.* 2041, two-st'y building; builder, W. B. Chapman, Twelfth St., bet. Christian and Carpenter Sts.

John Ord, architect, 31 South Fifteenth St., is making drawings for a large green-house, with dome at end, to be built at Villa Nova P. R. R., for Mr. Garrett; heated by hot water; cost, $15,000.

PROPOSALS.

July 31, 1888. Sealed proposals will be received at the office of the Supervising Architect, Treasury Department, Washington, D. C., until 2 o'clock P. M. on the 15th day of August, 1888, for the labor and materials required in the erection and completion of the additional basement and area walls, including excavation and concrete foundation for same for the Post-Office, Court-House, etc., building at Wichita, Kans., in accordance with the specification and drawings, copies of which may be seen at this office; the office of the Superintendent; Builders' Exchange, Cincinnati, O.; Builders' and Traders' Exchanges, Denver, Col., Kansas City, Mo., and Chicago, Ill.; N. W. Permanent Exhibit, Minneapolis, Minn., and the Superintendent of the Old Custom-House, St. Louis, Mo. Each bid must be accompanied by a certified check for $200. Upon receipt at this office of a post-office money order in amount two dollars ($2.00), drawn to the order of the Treasurer of the United States, parties will be furnished with copies of the drawings and specification. WILL. A. FRERET, Supervising Architect. 658

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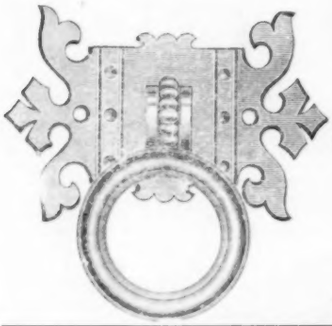

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Something New for the Stable.

Read's Patent Harness Bracket.

An Article long wanted but never before made.

Holds the whole harness, takes no more room than the ordinary hook or peg, can be used for both single and double harness. Gives the harness-case a neat appearance, as it carries the harness up uniformly in width with the saddle, beside keeping the bridle and breastplate in their proper shape. They are neatly japanned, with gilt facings. Price **$18** per dozen. Are now in use in over 100 first-class private stables in and about Boston.

Each bracket lettered **"J. J. Read, Boston, Mass."** For sale by dealers everywhere.

Indorsed and approved by the following named gentlemen, all of whom have them in use:

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The public are cautioned against all similar brackets, not marked with my stamp, as such brackets are infringements of patents held by me.

Also cedar-top riding-saddle bracket. Price $3.50 each. And whip-rack for English coach and straight whip combined. Price 50 cents each.

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NIGHTINGALE'S
Flat, Concrete Fireproof Construction,

AS ADOPTED IN HUNDREDS OF

Works, Mills, Factories, Banks, Flats, Public Buildings, etc.

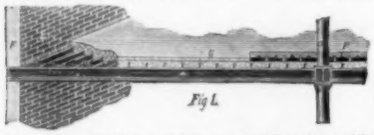


Fig 1.

A is the main girder resting on wall E and on pillar D. B are the small iron joists resting on main girder A and on wall at other end. C the iron joists B bedded in concrete and forming both floor and flat ceiling. F shows a portion of the floor C laid with patent solid and noiseless Wood Block Tiles.

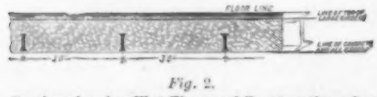
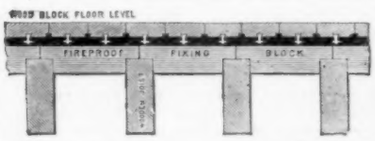


Fig. 2.

Section showing Flat Fireproof Construction where iron joists reston bottom flange of main girder and in which all ironwork is entirely protected from fire.



System of Making a Fireproof, Immovable, Solid and Noiseless Floor over Wooden Beams.

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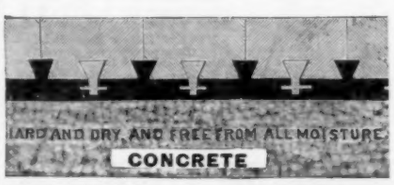
This forms a perfectly level and well bonded floor, strong and durable in all its parts. Indispensable to all who are and have been troubled and put to great expense by leaky floors. Perfectly Watertight. NO boarded floor required to be laid over Wooden Beams, FIREPROOF FIXING BLOCKS being used instead.



The best, cheapest, and most approved flooring possible for public and private buildings of every description. Wood blocks are dovetailed on under sides and ends to each other; and the underlying cement—after it has become quite hard and dry and free from all moisture, by means of a specially made antiseptic composition which forms a complete damp-course—prevents dry and wet rots and makes a thoroughly dry and warm floor. Forms one solid, compact mass, quite noiseless. No space underneath for rats, vermin, or dust to harbor. Air and water tight. Laid in various designs and in all kinds of woods. Very durable and lasting.

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